Edmund MAG 5 STAR ATLAS

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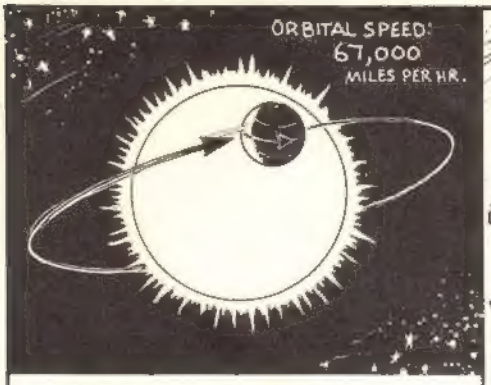
Edmund Scientific

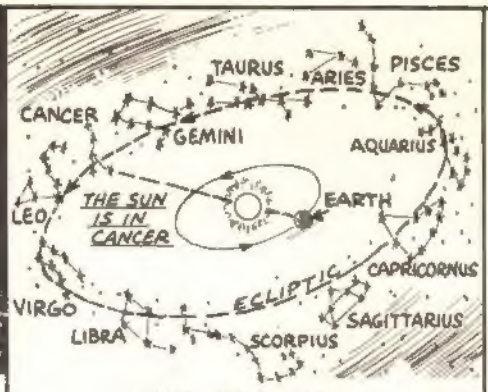
Basic Astronomy



MOVEMENT OF THE EARTH

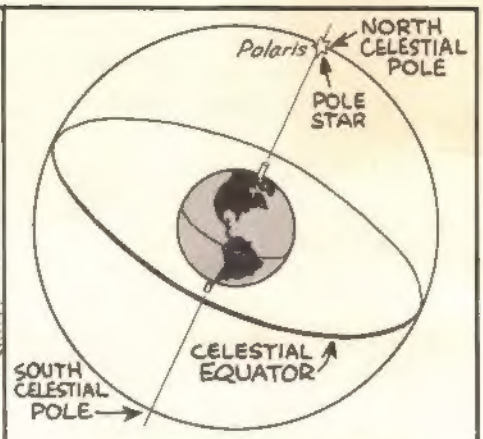
THE EARTH ROTATES ON ITS AXIS ONCE A DAY

THE EARTH MOVES AROUND THE SUN ONCE A YEAR. THE DAILY ADVANCE IS ABOUT 1° OF ARC OR 4 MIN. TIME



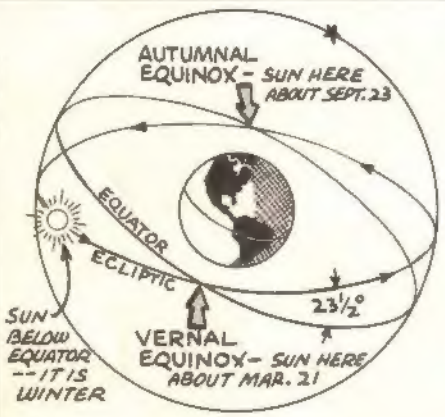
THE ECLIPTIC

IN ITS YEARLY JOURNEY AROUND THE SUN, THE EARTH TRACES A PATH AMONG THE STARS. THIS PATH IS THE ECLIPTIC. IT PASSES THRU MANY WELL-KNOWN CONSTELLATIONS



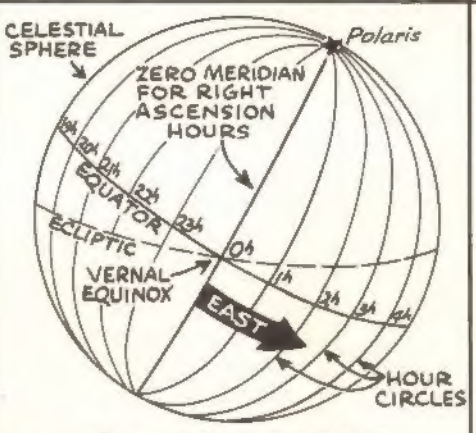
THE CELESTIAL SPHERE

THE IMAGINARY CELESTIAL SPHERE WITH THE EARTH AT CENTER HAS EQUATOR AND POLES... JUST LIKE THE EARTH



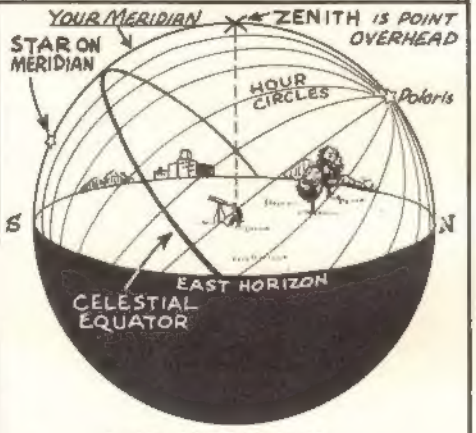
THE EQUINOXES

THE EQUINOXES ARE THE TWO POINTS WHERE THE ECLIPTIC CROSSES THE CELESTIAL EQUATOR



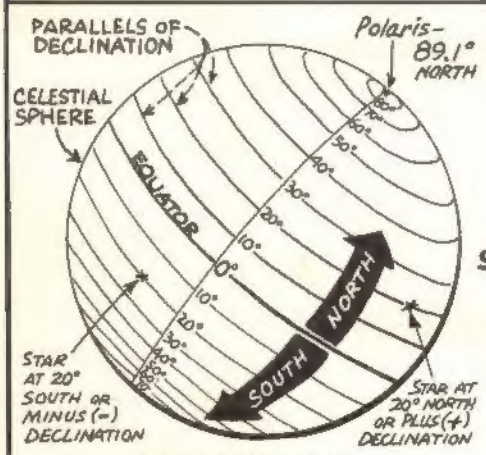
R.A. HOUR CIRCLES

RIGHT ASCENSION HOURS ARE SET OFF FROM THE VERNAL EQUINOX, EASTWARD. 1 HR. EQUALS 15°



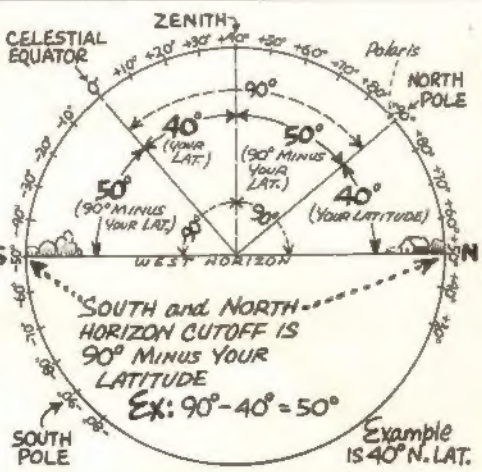
THE MERIDIAN

ANY NORTH-SOUTH CIRCLE ON THE CELESTIAL SPHERE IS A MERIDIAN. "THE MERIDIAN" MEANS YOUR NORTH-SOUTH LINE THRU YOUR ZENITH

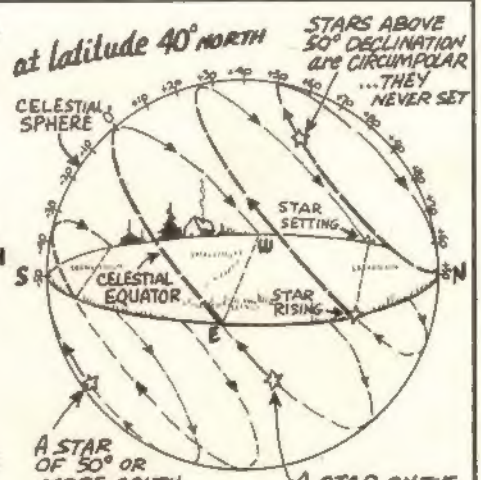


DECLINATION

DECLINATION IS MEASURED NORTH and SOUTH from the CELESTIAL EQUATOR... is like latitude on earth



DECLINATION DIAGRAM IS CONSTRUCTED BY PUTTING N. POLE AT SAME ANGLE AS YOUR LATITUDE



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EDMUND MAG 5 STAR ATLAS

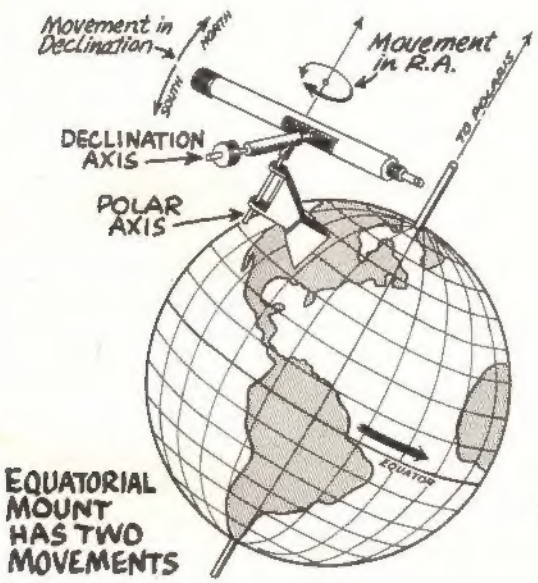
PLANET Earth moves around the sun, making a complete revolution in a time period which we know as a year. All the time it is orbiting around the sun, the earth is rotating on its axis, making one turn in a period which is known as a day. It is this daily rotation of the earth which gives us night and day. The whole system of time is based on one rotation of the earth.

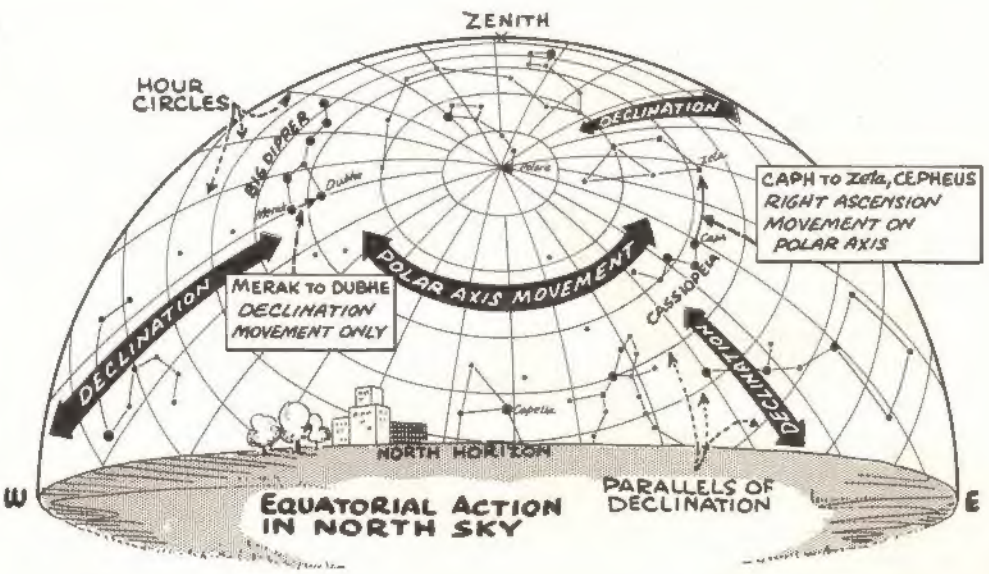
THE ECLIPTIC. In its yearly journey round the sun, the earth traces a path among the stars. This is the Ecliptic. You soon get to know the various constellations through which the ecliptic passes. A wider band of the sky covers an area 8 degrees on either side of the ecliptic. This is the Zodiac. In this area you will find the sun, the moon and all of the bright planets, except Venus may now and then stray a little outside of this zone.

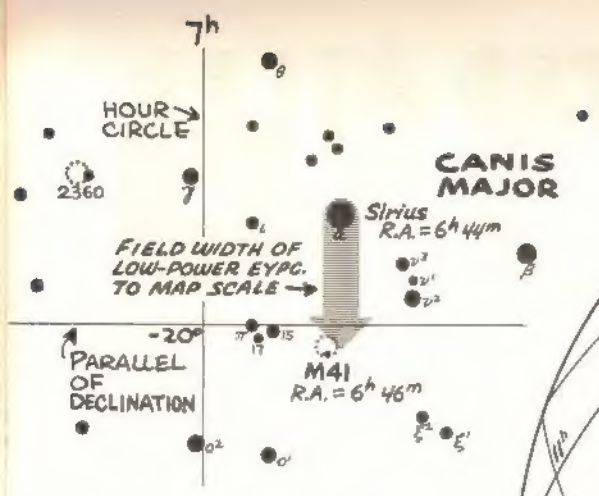
THE CELESTIAL SPHERE. All outer space can be imagined as a large sphere. Like the earth, it has an equator and north and south poles. Like the earth it is covered with an imaginary grid of guide lines which are used to give the position of any sky object. The north celestial pole is above your north horizon the same number of degrees as your latitude on earth. The celestial pole is approximately located by the bright star Polaris, which is currently less than 1 deg. from the true pole. It will approach even closer, and will be less than a half-degree from the pole in year 2100.

THE EQUINOXES. The equinoxes are the two points where the ecliptic crosses the celestial equator. The crossing when the sun is moving from south to north is the Vernal Equinox, which marks the beginning of spring. The other crossing is the Autumnal Equinox, marking the beginning of the Fall season. Midway between the equinoxes you have the sun at a maximum north point 23.5 deg. above the equator, and a maximum low point 23.5 deg. below the equator, these positions being the two Solstices. The high sun means of course, summer, while the low sun marks the beginning of winter. The exact dates for the equinoxes and solstices marking the seasons will vary a day or two in different years, with an average schedule of: Spring, March 20 or 21; Summer, June 21 or 22; Autumn, Sept. 23; Winter, Dec. 22.

RIGHT ASCENSION. Like the earth, the celestial sphere is imagined as being covered with a grid of guide lines. The great circles running from pole to pole are similar to the longitude circles on a globe or map of the earth. Since the sky sphere is 24 hrs. around, it has 24 main hour circles at 1 hr. intervals. The starting point is the Vernal Equinox, which is the zero point or 0-hr. The hour circles increase toward the east, going completely around the sky sphere to the starting point which is 24-hr. or 0-hr. The hour circles measure Right Ascension of any sky object, that is, the distance of any sky object from the vernal equinox in hours and minutes of time.

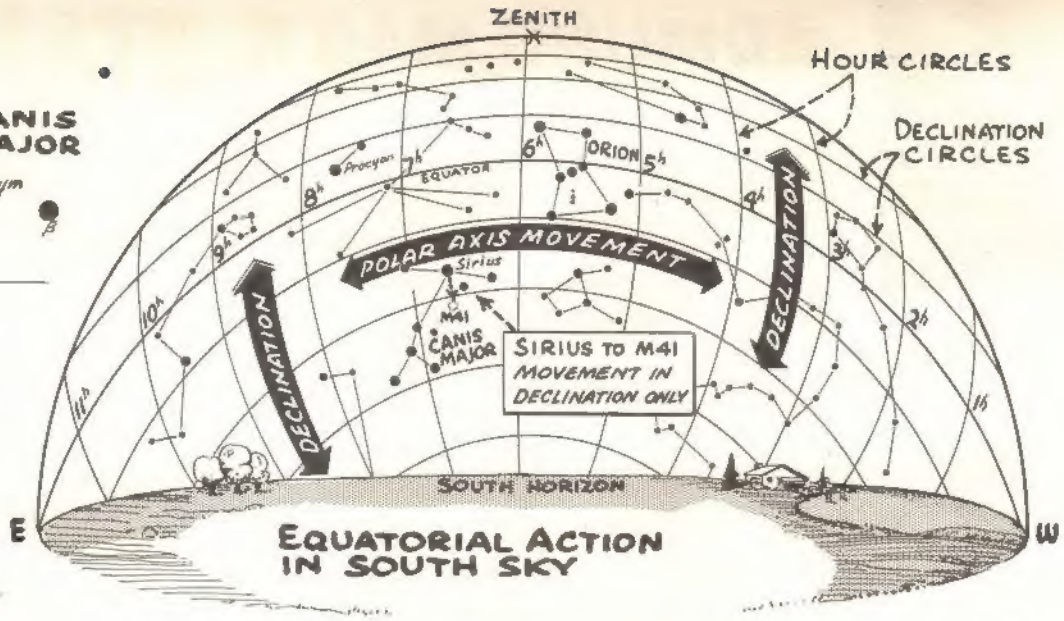






DECLINATION SWEEP

M41 IS EXACTLY 4° BELOW Sirius and NEARLY ON SAME LINE IN RIGHT ASCENSION



EQUATORIAL ACTION IN SOUTH SKY

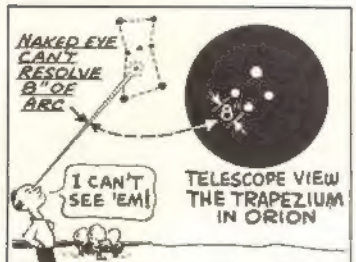
DECLINATION on the sky sphere is the same as latitude on earth. Declination is set off from the celestial equator and gives the position of a sky object in degrees and minutes of arc north or south of the equator. North declination is often indicated by the Plus sign (+), while south of the equator is negative (-). Declination is zero at the equator and extends 90 degrees to north pole and south pole. The grid of declination lines are usually called Parallels of Declination--they are circles but not great circles with the single exception of the equator.

Declination is oriented to your north-south position on earth. The north pole is above the horizon the same number of degrees as your latitude; the celestial equator is 90 deg. from the pole. Your south cutoff horizon is 90 deg. minus your latitude; your overhead point in declination degrees is the same as your latitude. It is a good idea to make a declination diagram for your own location, similar to the one shown. Also note and remember: Any star on or near the equator will rise and set due east and west. Any star north of the celestial equator will rise and set more or less to the north. Circumpolar stars are those that never set, and your limit for such stars is indicated by 90 deg. minus your latitude. Note that a star just outside your circumpolar circle will rise and set almost due north.

EQUATORIAL MOUNT. Any equatorial mount makes it easier to find sky objects because its movements follow the imaginary grid of lines on the celestial sphere. A mount like this is set up with its polar axis pointing to the north pole or to the star Polaris. The polar axis is the main or primary axis; branching from it is the secondary or declination axis. Any movement around the declination axis will move the telescope in a straight line directly toward or away from Polaris, as shown in the drawings. Any movement around the polar axis or shaft is a movement in Right Ascension--the telescope sweeps in a circle around the pole star. The general idea of the equatorial mount is that once you locate a known pilot or guide star, you can move from this starting point a certain distance in R.A. and a certain amount in declination to find an object which is not visible in your finder.

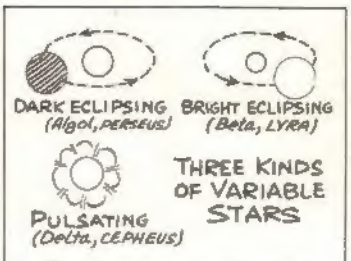
PRECESSION OF THE EQUINOXES. Since the vernal equinox marks 0-hr. right ascension, it would be nice to have this as a permanent fix. But the plain truth is that the juncture of the ecliptic and the equator slips westward at a rate of about 3.3 seconds of time per year. This means that the whole grid of guide lines--R.A. and declination--changes a little every year, the exact amount for any star or sky object depending on the general location of the object.

On a yearly basis, the precessional change means nothing at all to the average star-gazer, but in 40 years you have a minimal change of about 2.2 minutes of time for a star at the equator, and somewhat more for stars away from the equator, the extreme case being Polaris which moves nearly a half-hour because of the rapidly converging hour circles at the pole. All of this means simply that star catalogs and star maps go out-of-date in 40 or 50 years. The maps and star places in this atlas are for the year 1970 and so are currently (1974) nearly exact, and they will be close enough until about the year 2010.



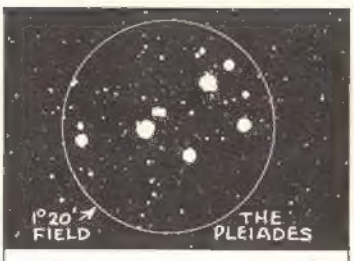
DOUBLE STARS

ONE OUT OF 15 STARS IS A DOUBLE OR MULTIPLE STAR AND ABOUT 500 OF THESE FROM 2 SECONDS TO 1 MINUTE OF ARC SEPARATION CAN BE "SPLIT" WITH SMALL TELESCOPES



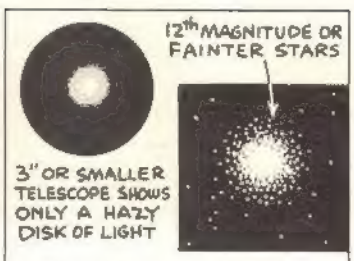
VARIABLE STARS

CHANGE IN BRIGHTNESS MAY TAKE A FEW HOURS OR MANY WEEKS, MAKING THE VARIABLE STAR A POOR "SHOW" OBJECT BUT IDEAL FOR SYSTEMATIC STUDY. *Algol IS MOST POPULAR*



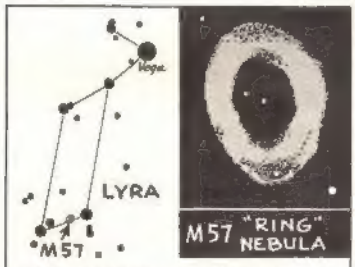
OPEN CLUSTERS

OPEN CLUSTERS OF STARS ARE A FAVORITE TARGET FOR THE TELESCOPE. 40 TO 60× IS ENOUGH FOR MOST GROUPS. POPULAR PLEIADES CLUSTER IS A FINE BINOCULAR OBJECT



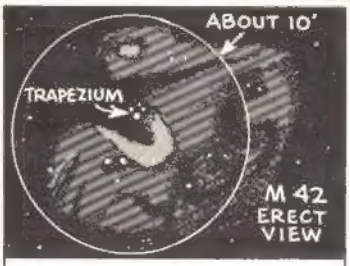
GLOBULAR CLUSTERS

A GLOBULAR CLUSTER IS A BALL OF STARS. INDIVIDUAL STARS ARE FAINT AND NEED 6" OR MORE APERTURE FOR RESOLUTION. M13 AND M22 ARE TWO BRIGHTEST



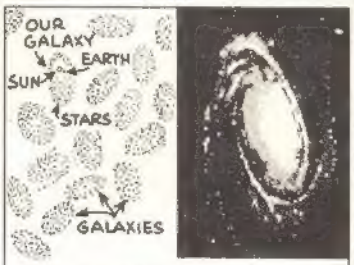
PLANETARY NEBULAE

PLANETARY NEBULAE ARE SO NAMED ONLY BECAUSE THEY ARE ROUND LIKE PLANETS. THEY ARE LUMINOUS GAS CLOUDS AND ARE A PART OF OUR GALAXY



DIFFUSE NEBULAE

A LARGE DIFFUSE GAS CLOUD LIGHTED BY THE STARS IN ITS VICINITY IS KNOWN AS A BRIGHT DIFFUSE NEBULA. M42 IN ORION IS IMPRESSIVE, EASILY SEEN WITH ANY TELESCOPE



EXTERNAL GALAXIES

GALAXIES ARE COMPLETE STAR SYSTEMS LIKE OUR OWN GALAXY. ALL ARE VERY DISTANT. M81 SHOWN IS ABOUT AS BRIGHT AS A STAR OF 9th MAGNITUDE

NO.	TYPE	CONS.	M.
M44	OPEN CL.	CANCER	3.7
M41	OPEN CL.	CANIS MAJ.	4.6
M24	OPEN CL.	SAGR.	4.6
M31	GALAXY	ANDR.	4.8
M35	OPEN CL.	GEMINI	5.3
M13	GLOBULAR	HERCULES	5.7
M22	GLOBULAR	SAGR.	5.9
M8	DIFFUSE NEB.	SAGR.	—
M42	DIFFUSE NEB.	ORION	—
M57	PLANETARY	LYRA	9.3

MESSIER OBJECTS

FRENCH ASTRONOMER, CHARLES MESSIER, MADE UP THE FIRST LIST OF SKY OBJECTS OTHER THAN STARS (1784). ALL OF THE 103 M-OBJECTS CAN BE SEEN WITH SMALL TELESCOPES

THE STAR MAPS in this booklet comprise a set of six double-page maps, one of which is circumpolar while the other five are equatorial segments, each covering 6 hours in right ascension. All stars to mag 5.0 are shown to 60 deg. south. The cutoff at mag 5.0 means that only the brighter of the mag 5 stars are shown. This cutoff matches very well what you can see naked eye on a clear night.

The circumpolar map is a conventional Polar Equi-distant Projection consisting of concentric circles equally spaced. This is accurate to angular scale in declination and is not too much off in right ascension.

The projection used for the segment maps is an old and simple style, sometimes called a Flamsteed projection because English astronomer, John Flamsteed, 1646-1719, used it. It was also used for the first American atlas--Burritt's--printed in 1856. In modern cartography it is called a sinusoidal projection because the meridians or hour circles are sine curves. This projection can be scaled in angular field in both declination and R.A., but only straight across the map and straight up and down, as described on page 31.

STAR NAMES. Starters in astronomy often wish that all the stars had proper names. In actual practice this is not so desirable because too many names or long numbers tend to clutter a map. The 20 or 30 names in common use give variety and are useful in identifying the bright stars. The most common system of star designation is by a letter of the Greek alphabet, first used by Bayer in 1601.

The next most used notation is the Flamsteed number. These are used over and over for each constellation. The number sequence is in order of R.A.

The third common naming system is a mixed bag of English letters, which is at times confusing because some English letters look just the same as some Greek letters. A nice feature is that caps from R to Z and all double caps like BZ tell you at once that the star is a variable.

KINDS OF SKY OBJECTS. The two main kinds of sky objects are clusters and nebulas. Clusters are further classified as being either open or globular, while the main kinds of nebulas rate separate grouping as planetary, bright diffuse and external. Stars also get a further classification as being either variable or double. A thumbnail sketch of each kind of object is given in the drawing above.

observing HINTS

THE BEGINNER should put in an hour or so of practice on land objects. Even though the image is upside down, you will gain valuable experience in setting up the telescope, focusing the eyepiece and other basic operations, all of which must be learned by actual practice. Then, in the night sky, the best starting sky is at dusk.

EYES MUST BE DARK-ADAPTED. It takes at least ten minutes to dark-adapt your eyes and slight improvement can be noted up to half-an-hour. If the weather outdoors is a bit chilly, you can get your night eyes more comfortably by staying indoors with your eyes closed or in a dark room. Meanwhile, you have already setup the telescope and it too is undergoing a slight change in adapting to the weather. If you want to look at maps or notes outdoors, use a lamp or flashlight covered with red or brown paper or a red filter.

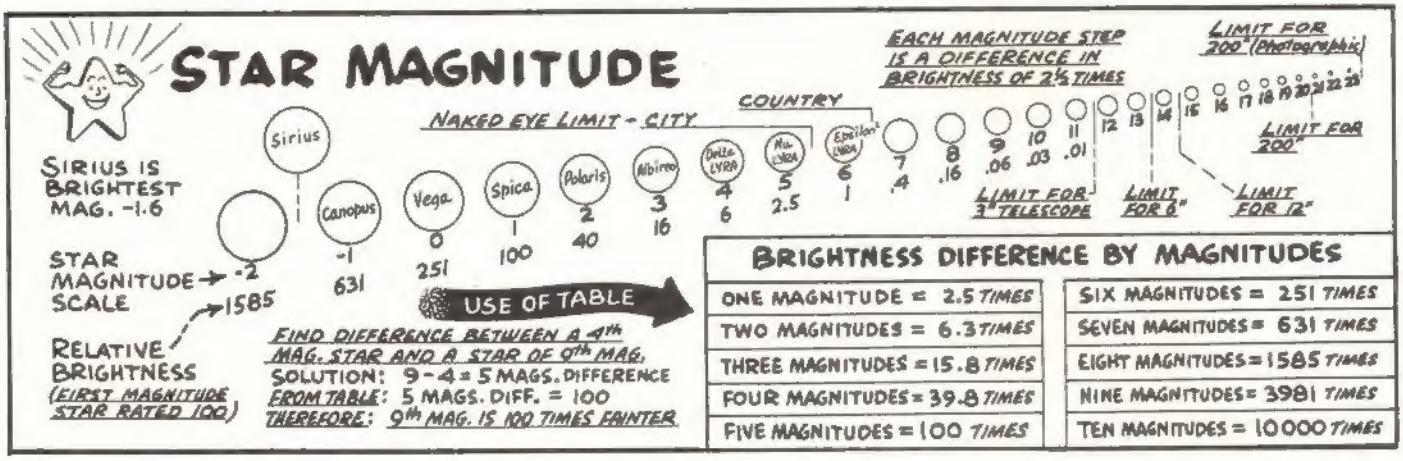
EYE POSITION. Your eye must not touch the eyepiece but at the same time it must be centered on the emergent light beam. This is impossible to do when your eyes are not dark-adapted. After you get your night eyes, you will note that the sky as seen in the telescope is not really black but a rather bright, luminous gray. Given this target, your eye will automatically center on the eyepiece. Obviously, a low-power eyepiece is easier to use because it has a bigger exit pupil. If desired, you can cup your hand around the eyepiece to serve as a guide until you get your eye centered on the light beam.

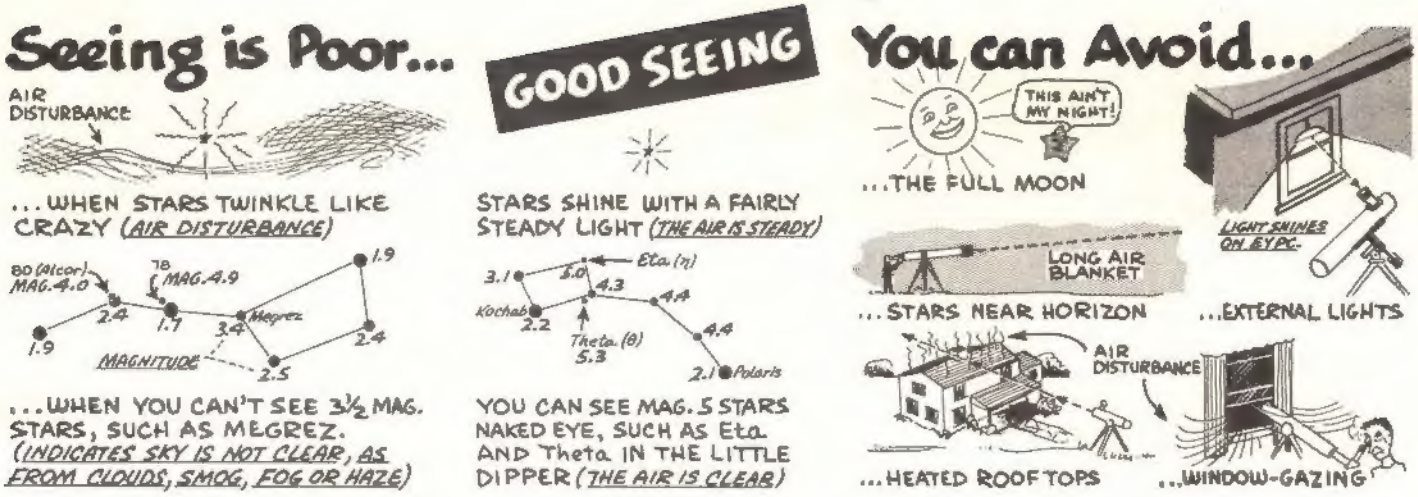
IF YOU WEAR GLASSES. Take them off if you are far sighted. Your unaided eyes will then see distant objects clearly, while the removal of the glasses will let you crowd the eyepiece when necessary. Myopes have a different problem: if you remove your glasses you lose your eyes for distant objects. The best practical solution here is to keep your glasses on and use only eyepieces with long eye relief of 1/2 inch or more. Note, however, that even with eyepieces having short eye relief, a long eye position means only that you lose field.

FOCUSING. There is no such thing as exact focusing of a telescope. What happens is that the image forms at a very precise and exact image plane, but you can see the image at various settings of the eyepiece because the eye can adjust for either long or short focus. The best general practice is to focus "long". This is done by extending the eyepiece a little more than necessary and then focusing in just enough to get a sharp image. The "long" focus causes your eye to focus as for a distant object--the most comfortable position. If you focus to the maximum "in" position which yet retains a sharp image, the eye accommodates as for a close object. This position gives slightly greater magnification but is somewhat more tiring. In actual practice, you will use both the long and short focus since frequent changes will allow you to see clearer without eye fatigue. Also, as a matter of fact, objects low in the sky require a slightly different focus then objects at the zenith; a bright object like the moon may require different focusing than a dim nebula. Exact focus on star objects is simply a matter of obtaining the smallest possible star image.

Out-of-focus focusing is sometimes useful. For example, if the finder telescope is set slightly outside focus, the star images will be big and easily seen; you can even make fine crosshairs visible in this manner. Colored doubles are sometimes seen better slightly outside focus.

AVERTED VISION. On luminous objects, you can increase visual acuity by one or two magnitudes by using averted vision. The idea is to get the target





object in the center of the field, and then instead of looking directly at it, direct your gaze a little to one side. This technique is especially useful for star clusters. The center of your eye sees the sharpest, but the outer portion is more sensitive to light and movement.

VIBRATION OF MOUNT. At 50x or less, a sturdy mount can be pushed around without disturbing the image--you can do continuous tracking, manually. Light-duty mounts will show some vibration at any power. All you can do is to get on the target as gently as possible and then get your hands off the mount and let it settle down. A vibration period of 6 to 8 seconds is normal--anything over 12 seconds indicates a poor mount. When making the initial sight, you should practice the little trick of allowing for drift. Assuming a south sky object, the image should be positioned near the west side of eyepiece. It will then drift to the east side, during which time it will do its little shimmy and settle down, allowing one to four minutes of viewing time. Of course there is much less drift if you are on clock drive. A clock drive will usually run smoother if you balance the scope so that it is a little heavy to the west, with the result the clock acts only as an escapement movement.

It is easy to demonstrate that any portable telescope vibrates by tapping your finger gently on the focusing tube. The image will immediately go into an elliptical or figure-eight movement--really quite pretty although not what you want. Do this with a bright star near the horizon and off-focus the image a little--you will see a flaming pinwheel shooting off red and green sparks!

GOOD SEEING. The star-gazer's "good seeing" depends on many things but specifically it is concerned with the atmosphere or air. The main body of the earth's atmosphere is about ten miles thick straight up. At 45 degrees, it is about 15 miles thick, while near the horizon the air blanket can be 100 miles or more. Obviously, the best seeing is at the zenith where the air blanket is thin. The atmosphere is constantly in motion--shifting, swirling, boiling--and it is a rare night when you can use powers over 300x regardless of the size or excellence of your telescope. On the other hand, atmospheric disturbances are seldom a problem at 50 to 100x except for extreme cases where you are looking over a hot chimney or through an open window. Window viewing is practical only when indoor and outdoor air are about the same temperature. Even so, a power of 50x is tops for this kind of viewing.

IS FOR ALPHA — THE GREEK ALPHABET

(ALPHA) (BETA)

A	α	ALPHA	AL-fuh	I	ι	IOTA	ī-OH-tuh	P	ρ	RHO	Row (YOUR BOAT)
B	β	BETA	BAY-tuh	K	κ	KAPPA	CAP-uh	Σ	σ	SIGMA	SIG-muh
T	γ	GAMMA	GAM-uh	Λ	λ	LAMBDA	LAM-duh	T	τ	TAU	Taw
Δ	δ	DELTA	DELL-tuh	M	μ	MU	Mew or Moo	Y	υ	UPSILON	UP-sih-lon
E	ε, ε	EPSILON	EPP-sih-lon	N	ν	NU	New or Noo	Φ	φ	PHI	Fie
Z	ζ	ZETA	ZAY-tuh	Ξ	ξ	XI	Zi (NOTE Z SOUND)	X	χ	CHI	Kie
H	η	ETA	AY-tuh	O	ο	OMICRON	OHM-ih-krawn*	Ψ	ψ	PSI	Sie (sigh)
Θ	θ	THETA	THAY-tuh	Π	π	PI	Pie	Ω	ω	OMEGA	Oh-ME-guh

*LIKE Omelet, Omnibus

The Time is L.M.T.

ALL MAPS in this atlas have a date scale for 8:00 Local Mean Time. Between L.M.T. and Standard Time, there is a small difference of one to thirty minutes or more, which for some uses of a map or a planisphere is not worth bothering about. Specifically, if your time correction is 10 min. or less, you can say standard time is the same as mean time. In no case, however, can you neglect the Daylight time difference, which is a whole hour more than standard time.

Local Mean Time differs from Standard Time by 4 minutes for each degree of longitude you are away from the central meridian of your Time Zone. At the central meridian of any zone, standard time is identical with local mean time. Elsewhere in the zone you must first find the longitude of your location from an atlas, and from this data you can calculate your Time Correction as shown by the example on opposite page.

Time conversion is a two-way street, that is you can convert mean to standard or standard to mean. Either way makes use of your time correction; the right formula to use is shown in the box below. For the purpose of using a map with a date scale as shown in this book, the best solution is to change the mean time of the map to its equivalent standard time or daylight time. The situation here is that you have only the one time base for the map--8 o'clock L.M.T.--so you change this single item to standard time.

For the Akron, Ohio, example shown, you will get the same result whether you use 8:00 mean time or 8:26 standard time or 9:26 Daylight time. All you do is locate the month and day on the date scale. Directly under this, you can read the R.A. of your meridian. You will seldom use the maps at exactly 8:00 mean time or the corresponding time in either standard or daylight time. You will usually be a certain interval of time past the base time. Figure out what this is, and then increase the R.A. of your meridian by the same amount. This will bring you to a new and greater R.A. on the map, and this R.A. is your actual meridian at the moment, that is the indicated R.A. will be directly down the middle of the sky although it is not likely it will be at the center of the map.

A different conversion is used if you are using a planisphere. In this case, all of the times shown on the time dial are local mean time. So, instead of changing the whole dial, you convert your time of observation to mean time--the conversion is standard-to-mean. Assuming your household clock reads Daylight time of 9:26, you deduct 1 hr. from this to get 8:26 standard time. Then, you add or subtract the time correction as needed. For the Akron, Ohio example shown, you reduce any desired instant of Daylight time by 1 hr., 26 min. to get L.M.T., which is used to set the planisphere.

TIME CONVERSIONS

IF You are WEST of CENTRAL MERIDIAN of your TIME ZONE

Example: AKRON, Ohio
TIME CORRECTION = 26m West
GIVEN TIME: 8:00 L.M.T.

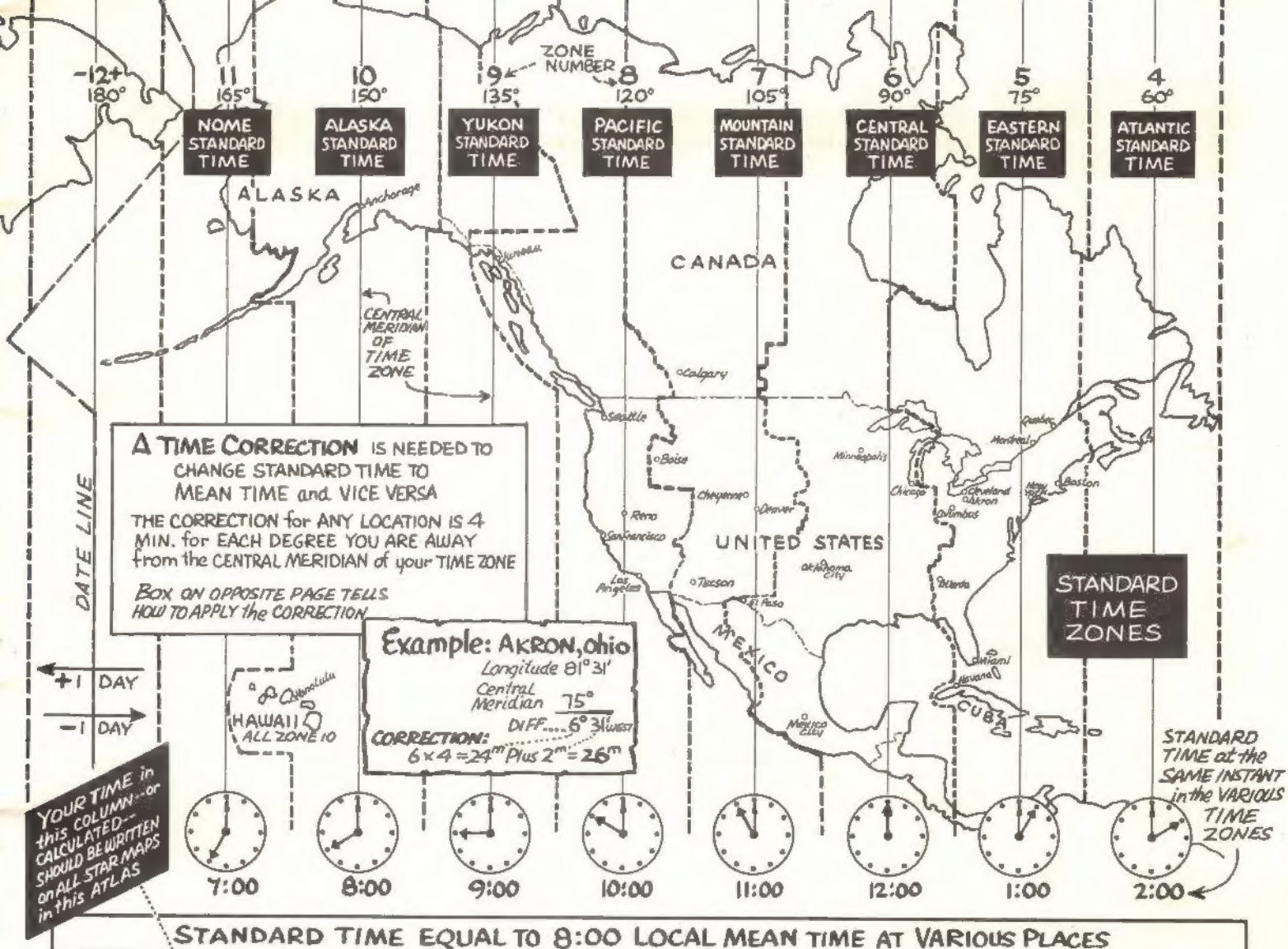
MEAN TO STANDARD	STANDARD TIME = L.M.T. *Plus* TIME CORRECTION	STANDARD TIME = 8h 00m L.M.T. Plus 26m CORRECTION 8:26 E.S.T.
STANDARD TO MEAN	LOCAL MEAN TIME = STANDARD TIME *Minus* TIME CORRECTION	MEAN TIME = 8h 26m STANDARD TIME Minus 26m CORRECTION 8:00 L.M.T.

ALL CASES: STANDARD TIME IS 1-HOUR LESS THAN DAYLIGHT TIME

IF You are EAST of CENTRAL MERIDIAN of your TIME ZONE

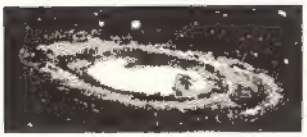
Example: LOS ANGELES, CAL.
CORRECTION = 7m East
GIVEN TIME: 8:00 L.M.T.

MEAN TO STANDARD	STANDARD TIME = L.M.T. *Minus* TIME CORRECTION	STANDARD TIME = 8h 00m = 7h 60m Minus 07m = 07m 7:53 P.S.T.
STANDARD TO MEAN	LOCAL MEAN TIME = STANDARD TIME *Plus* TIME CORRECTION	MEAN TIME = 7h 53m Plus 07m 7h 60m = 8:00 L.M.T.



STANDARD TIME EQUAL TO 8:00 LOCAL MEAN TIME AT VARIOUS PLACES

PLACE	TIME	ZONE	LAT.	LONG.	PLACE	TIME	ZONE	LAT.	LONG.	PLACE	TIME	ZONE	LAT.	LONG.	PLACE	TIME	ZONE	LAT.	LONG.
AKRON, OHIO	8h 26m	5	41° 05'	81° 31'	DULUTH, MINN.	8h 08m	6	46° 47'	92° 06'	LOS ANGELES	7h 53m	8	34° 03	118° 14'	ST. LOUIS, MO.	8h 01m	6	38° 38'	90° 12'
ALBANY, N.Y.	7 55	5	42 39	73 45	EL PASO, TEX.	9 06	6	31 46	106 29	LOUISVILLE, KY.	7 43	6	38 15	85 46	ST. PAUL, MINN.	8 12	6	44 57	93 06
ANCHORAGE	8 00	10	61 13	149 54	ELIZABETH, N.J.	7 57	5	40 40	74 13	LOWELL, MASS.	7 45	5	42 38	71 19	SALT LAKE CITY	8 28	7	40 45	111 53
ATLANTA, GA.	8 38	5	33 45	82 24	ERIE, PA.	8 20	5	42 07	80 05	LUBBOCK, TEX.	8 47	6	33 35	101 51	SAN DIEGO, CAL.	7 49	8	32 43	117 09
ATLANTIC CITY	7 58	5	39 22	74 26	FARGO, N.D.	8 27	6	46 53	96 47	MADISON, WIS.	7 58	6	43 04	89 23	SAN FRANCISCO	8 10	8	37 47	122 25
AUGUSTA, GA.	8 28	5	33 28	81 58	FLINT, MICH.	8 35	5	43 01	83 42	MEMPHIS, TENN	8 00	6	35 09	90 03	SAN JUAN, P.R.	8 25	4	18 30	66 10
AUGUSTA, ME.	7 39	5	44 19	69 46	FT. WAYNE, IND.	7 41	6	41 04	85 08	MIAMI, FLA.	8 21	5	25 47	80 12	SANTE FÉ, N.M.	8 04	7	35 41	105 56
BALTIMORE, MD.	8 06	5	39 17	76 37	FT. WORTH, TEX.	8 29	6	32 45	97 20	MILWAUKEE WIS.	7 52	6	43 02	87 54	SCRANTON, PA.	8 03	5	41 25	75 40
BANGOR, ME.	7 35	5	44 48	68 46	GARY, IND.	7 49	6	41 36	87 21	MINNEAPOLIS	8 13	6	44 59	93 16	SEATTLE, WASH.	8 09	8	47 37	22 20
BERKELEY, CAL.	8 09	8	37 52	122 16	GRANDRAPIDS	8 43	5	42 58	85 40	MOBILE, ALA.	7 52	6	30 42	88 03	SIOUX FALLS, S.D.	8 27	6	43 33	96 44
BISMARCK, N.D.	8 43	6	46 48	100 47	HARTFORD, CON.	7 51	5	41 46	72 41	MONTREAL	7 54	5	45 30	73 35	SITKA, ALASKA	9 01	8	57 10	135 15
BOISE, IDAHO	8 45	7	43 37	116 12	HAVANA, CUBA	8 30	5	23 08	82 23	MUNCIE, IND.	7 42	6	40 11	85 23	SOUTH BEND	7 45	6	41 41	86 15
BOSTON, MASS	7 44	5	42 21	71 03	HELENA, MONT.	8 28	7	46 36	112 02	NASHVILLE, TENN	7 47	6	36 10	86 47	SPOKANE, WASH.	7 50	8	47 40	117 26
BUFFALO, N.Y.	8 15	5	42 53	78 52	HONOLULU	8 31	10	21 18	157 50	NEEDLES, CAL.	7 38	8	34 50	114 36	SPRINGFIELD, ILL.	7 59	6	39 48	89 39
CALGARY, CAN.	8 36	7	51 01	114 01	HOUSTON, TEX.	8 21	6	29 45	95 22	NEW HAVEN, CONN.	7 52	5	41 18	72 56	SPRINGFIELD, MASS	7 50	5	42 06	72 36
CARLSBAD, N.M.	7 57	7	32 26	104 15	INDIANAPOLIS	7 45	6	39 46	86 10	NEW ORLEANS	8 00	6	29 57	90 04	SPRINGFIELD, MO.	8 13	6	37 13	93 18
CHAMPAIGN, ILL.	7 53	6	40 07	88 15	JERSEY CITY	7 56	5	40 44	74 04	NEW YORK, N.Y.	7 56	5	40 45	74 00	SPRINGFIELD, O.	8 35	5	39 56	83 48
CHARLESTON, S.C.	8 20	5	32 47	79 56	JOHNSTOWN, PA.	8 16	5	40 20	78 55	NOME, ALASKA	8 02	11	64 25	165 30	STAMFORD, CONN	7 54	5	41 03	73 32
CHARLESTON, W.V.	8 27	5	38 21	81 38	JUNEAU, ALASKA	8 58	8	58 18	134 24	OAKLAND, CAL.	8 09	8	37 48	122 16	SYRACUSE, N.Y.	8 05	5	43 03	76 09
CHEYENNE, WYO	7 59	7	41 08	104 49	KANSAS CITY, MO	8 18	6	39 05	94 35	OGDEN, UTAH	8 28	7	41 14	111 58	TACOMA, WASH.	8 10	8	47 15	122 26
CHICAGO, ILL.	7 51	6	41 52	87 38	KENOSHA, WIS.	7 52	6	42 36	87 50	OKLAHOMA CITY	8 30	6	35 28	97 31	TAMPA, FLA.	8 30	5	27 57	82 27
CINCINNATI, O.	8 38	5	39 06	84 31	KEY WEST, FLA.	8 27	5	24 34	81 48	OMAHA, NEB.	8 24	6	41 16	95 56	TORONTO, CAN.	8 18	5	43 40	79 24
CLEVELAND, O.	8 27	5	41 30	81 42	KNOXVILLE, TENN	8 36	5	35 58	83 55	PEORIA, ILL.	7 58	6	40 42	89 36	TOLEDO, OHIO	8 34	5	41 39	83 33
COLUMBUS, GA.	8 40	5	32 28	84 59	LAFAYETTE, IND.	7 48	6	40 25	86 54	PHILADELPHIA	8 01	5	39 57	75 09	TOPEKA, KAN.	8 23	6	39 03	95 40
COLUMBUS, O.	8 32	5	39 58	83 00	LANCASTER, PA.	8 05	5	40 02	76 18	PHOENIX, ARIZ.	8 28	7	33 27	112 04	TROY, N.Y.	7 55	5	42 44	73 41
CONCORD, N.H.	7 46	5	43 12	71 32	LANSING, MICH.	8 38	5	42 44	84 33	PITTSBURGH	8 20	5	40 26	80 00	UTICA, N.Y.	8 01	5	43 06	75 14
CORPUS CHRISTI	8 30	6	27 48	97 24	LAREDO, TEX.	8 38	6	27 30	99 31	PORTLAND, ME.	7 41	5	43 40	70 15	WASHINGTON, D.C.	8 08	5	38 54	77 01
DALLAS, TEX.	8 27	6	32 47	96 48	LAS VEGAS, NEV.	7 41	8	36 10	115 09	PORTLAND, ORE.	8 11	8	45 31	122 41	WATERBURY, CON.	7 52	5	41 33	73 03
DAVENPORT, IA.	8 02	6	41 31	90 35	LAWRENCE, MASS.	7 45	5	42 42	71 10	QUEBEC, CAN	7 45	5	46 49	71 11	WHEELING, W.VA.	8 23	5	40 04	80 43
DAYTON, OH.	8 37	5	39 46	84 12	LEWISTON, IDAHO	7 48	8	46 24	117 02	RALEIGH, N.C.	8 15	5	35 47	78 38	WICHITA, KAN	8 29	6	37 42	97 20
DAYTONA BEACH	8 24	5	29 13	81 01	LEXINGTON, KY.	7 38	6	38 03	84 30	READING, PA.	8 04	5	40 20	75 56	WILKES-BARRE	8 04	5	41 15	75 53
DECATUR, ILL.	7 56	6	39 51	88 57	LIMA, OHIO	8 36	5	40 45	84 06	RENO, NEV.	7 59	8	39 31	119 49	WILMINGTON, DEL.	8 02	5	39 45	75 33
DENVER, COL.	8 00	7	39 45	104 59	LINCOLN, NEB.	8 27	6	40 49	96 42	RICHMOND, VA.	8 10	5	37 32	77 26	WORCESTER, MASS	7 47	5	42 16	71 48
DESMOINES, IO.	8 14	6	41 35	93 37	LITTLE ROCK, ARK.	8 09	6	34 45	92 17	ROANOKE, VA.	8 20	5	37 16	79 57	YONKERS, N.Y.	7 56	5	40 56	73 54
DETROIT, MICH	8 32	5	42 20	83 03	LONG BEACH, CAL.	7 53	8	33 46	118 11	SACRAMENTO	8 06	8	38 35	121 30	YOUNGSTOWN, O.	8 23	5	41 06	80 39



selected sky objects

MAP 1

IF YOU live on or near latitude 40-deg. north, all of the stars in Map 1 are circumpolar, meaning they move in circles around the pole and are never out of sight. This allows a choice of viewing any circumpolar star on any night at any hour throughout the year. However, the best field is on the meridian above the pole; east and west from the pole a full 90 degrees is almost as good. Stars are rarely viewed below the pole, that is on the horizon side.

When you use Map 1 you should face north. The map can be on a table or you may prefer to hold it erect or even at 45 degrees to match the plane of the map to the curve of the sky. In this position you can see that stars at the top of the map above the pole extend southward nearly to your zenith. The bottom of the map will show stars from the pole to your horizon. As drawn, the map has 18-hrs. R.A. on the meridian with the well-known Big Dipper in the western sky and rich Cassiopeia to the east. Of course in actual use of the map you turn it around as needed to put the current date at the top. Polaris is in the Cass side of sky about on a line from Epsilon Cass to Alkaid; a more accurate line is between 50 Cass and Thuban.

STAR NAMES MAP 1

ALCOR	AL-cor	URSA MAJOR
ALDERAMIN	al-DARE-uh-min	CEPHEUS
CAPH	kaff	CASSIOPEIA
ELTANIN	el-TAY-nin	DRACO
also ETAMIN	ETT-uh-min	DRACO
KOCHAB	KOE-kab	URSA MINOR
POLARIS	pole-AIR-iss	URSA MINOR
RUCHBAH	RUCK-bah	CASS.
SCHEDIR	SHED-durr	CASS.
THUBAN	THEW-ban	DRACO

DIPPER STARS

ALIOTH	ALLEY-oth	all URSA MAJOR
ALKAID	al-KADE	
DUBHE	DUBB-be	
MEGREZ	ME-grez	
MERAK	ME-rack	
MIZAR	MY-zar	
PHECDA	FECK-dah	

SCHEDIR in Cassiopeia is a wide double star showing a mag 2.3 reddish-white and mag 9 blue, spread 62 seconds of arc.
Place: 0h 39m 56.4 deg. North

ETA in Cassiopeia is a double showing a mag 3.6 yellow-white primary and a much fainter mag 7.6 companion of reddish-purple complexion, separated by 12 sec. of arc.
Place: 0h 47m 57.7 deg. North

NGC 457 in Cassiopeia is an open cluster of about 40 stars in a 4' field.
Place: 1h 14m 58.7 deg. North

M 103 is a fan-shape open cluster in Cass of about 60 stars in a 6' field. Included in the group are four about mag 7 and a mag 8 red. One of the bright stars is a double, being Struve No. 131, mag 6.0 light yellow and mag 9.2 dusky blue at 14 seconds.
Place: 1h 31m 60.5 deg. North

M 76 is a faint pearly-white planetary in Perseus about 1' x 2' in size. The longish shape is brighter at either end in the manner of the Dumbbell nebula, M27.
Place: 1h 40m 51.4 deg. North

NGC 663 is an open cluster in Cassiopeia showing about 80 stars in a 12' field. Includes Struve No. 153 double, mags 8.5 and 9.7 at 8 sec. Two small clusters can be seen north and south at less than 1 degree.
Place: 1h 44m 61.1 deg. North

POLARIS is the pole star and is currently (1973) 52' from the north pole. It will move closer each year, reaching the minimum distance of 26' in the year 2100. The pole star is bright at mag 2, easy to find. A casual look will never show it, but Polaris has a little mag 9 companion tagging along at 18 seconds.
Place: 2h 4m 89.1 deg. North

IOTA CASS is a colorful triple star with a mag 4.2 primary. The brighter companion is mag 7.1 at 2.2 sec., with the third star mag 8.1 at 7.5 seconds. The close pair needs at least 140x for a clean split.
Place: 2h 27m 67.3 deg. North

NGC 1502 open cluster in Camelopardus has only about 15 stars, the whole rated mag 5 in a 7' field. Includes the double star Struve 485, mag 6.1 white and mag 6.2 bluish at 18 seconds. Several other stars in the group are also companions or doubles.
Place: 4h 5m 62.3 deg. North

NGC 1528 is an open cluster in Perseus showing about 80 stars in a 25' field. "Good low-power object." --Webb.
Place: 4h 13m 51.2 deg. North

MESSIER 81 is a spiral galaxy in Ursa Major about 10 x 16' in size. Rated about mag 7 and is easy to pick up with any telescope but resolution needs big aperture.
Place: 9h 53m 69.2 deg. North

MESSIER 82 is also a spiral but seen more edge-on. It is about half the size of M 81--both can be seen side by side in a low-power field.
Place: 9h 54m 69.8 deg. North

M 97 is the Owl nebula, nesting under the Big Dipper. It is a planetary and large for this type of object at 180 sec. of arc diameter, but dim at mag 11.
Place: 11h 13m 55.2 deg. North

NO. 32 in Camelopardus is also known as Struve 1694 and is a double star mags 5.3 and 5.8, both bright white. The separation is 22 seconds.
Place: 12h 49m 83.6 deg. North

MIZAR in the handle of the dipper is one of the most popular of all double stars. The stars are mags 2.4 and 4.0, both white, 14 sec. apart. A low-power field takes in mag 4 Alcor about 12' from Mizar.
Place: 13h 23m 55.1 deg. North

17 DRACO is a wide optical with No. 16 at 90 seconds. No. 17 itself is a close binary mags 5.5 and 6.6 at 4 seconds. If you can split the close pair you have a triplet--it takes about 120x.
Place: 16h 36m 53.0 deg. North

selected SKY OBJECTS
MAP 2

PSI in Draco is an optical double in a spread of 30 sec. of arc. The stars are white mags 4.9 and 6.1. A sweep in R.A. from Gamma in the Little Dipper will find them.
Place: 17h 43m 72.2 deg. North

NGC 6543 is a pale blue planetary nebula with poorly defined edges located in the first bend of the dragon's body. It is rated 22 sec. diameter, but a 3-in. shows only about 15 seconds, much like a faint star out of focus.
Place: 18h 0m 66.6 deg. North

NO. 41 DRACO is an optical pair with No. 40, the two having a combined magnitude of 5.0. Both stars are yellow-white and stand 20 sec. apart.
Place: 18h 3m 80.0 deg. North

OMICRON in Draco is a double of mag 4.8 yellow-orange and mag 7.6 lilac separated by 34 seconds of arc. Easy in any telescope.
Place: 18h 51m 59.4 deg. North

NGC 6939 open cluster in Cepheus shows about 80 minute stars in a fan-shaped figure 8' diameter.
Place: 20h 31m 60.5 deg. North

BETA in Cepheus is a double star showing a white mag 3 primary and blue mag 8 companion at 14 seconds. Nice object for 3-in. refractor.
Place: 21h 28m 70.4 deg. North

XI in Cepheus is a neat double with mag 4.6 primary and mag 6.5 companion, both bluish, spread 7 sec. of arc.
Place: 22h 3m 64.5 deg. North

DELTA, Cepheus is the type star of the Cepheid variables with a magnitude range from 3.6 to 4.3 in 5.4 days. It is also a nice double showing a mag 4.0 orange primary and a mag 7.5 blue companion at 41 seconds.
Place: 22h 28m 58.3 deg. North

M 52 is a bird-in-flight group of about 120 small stars with a mag 8 orange star at the head. Somewhat like popular M 11 but less bright. Messier described it as "a mass of very small stars blended with nebulous matter and requiring a good telescope to distinguish them."
Place: 23h 23m 61.4 deg. North

BETA, Capricorn is a wide optical pair at 205 sec. of arc. Primary mag 3.2 orange-yellow with sky blue companion mag 6.2.
Place: 20h 19m 14.9 deg. South

MESSIER No. 29 is an open cluster about 2 deg. south of Gamma (Sadr) in Cygnus. It shows about 20 stars in a 12' field. About half of the stars are mag 10 or brighter.
Place: 20h 23m 38.4 deg. North

OMICRON in Capricorn shows a pair of bluish stars mags 6.1 and 6.6 at 22 sec. of arc.
Place: 20h 28m 18.7 deg. South

NGC 7009 is a planetary called the Saturn Nebula because it shows a trace of a ring system like planet Saturn. The telescope appearance is a bright, greenish ellipse without detail.
Place: 21h 2m 11.5 deg. South

NO. 61 CYGNUS is a long-period binary showing stars of mag 5.5 and mag 6.3--both yellow but the smaller one more so. 29 seconds.
Place: 21h 6m 38.6 deg. North

M 15 GLOBULAR in Pegasus is an 8' bundle of stars branching out from a central blaze. In the stragglers you may be able to resolve the brighter stars with a 6-in. reflector.
Place 21h 29m 12.0 deg. North

M 39 is a loose cluster in Cygnus showing about 25 stars on the rich background of the Milky Way.
Place: 21h 31m 48.3 deg. North

M 2 is a perfectly round globular cluster in Aquarius about 8 min. of arc diameter. It is rated mag 7 which means the thousands of individual stars lumped together would be about as bright as a mag 7 star.
Place: 21h 32m 1.0 deg. South

MU, CEPHEUS is known as Herschel's Garnet Star. All of the red stars appear somewhat redder in refractors--this one is almost a true red in a 3-in. glass at 45x.
Place: 21h 43m 58.7 deg. North

PI, PEGASUS at mag 4.4 has Flamsteed No. 27 of mag 5.6 longside and the two form a pretty optical pair. Both stars are yellow. This is a nice 7x50 binocular object in which the 1/4-deg. spread is only about 1/28 of the field.
Place: 22h 9m 33.0 deg. North

NGC 7243 in Lacerta is an open cluster showing about 40 stars from mag 9 to mag 14 in a 20' field.
Place: 22h 14m 49.7 deg. North

ZETA, AQUARIUS is a close double with separation of 1.7 sec. of arc (1975). Both stars are white, mags 4.4 and 4.6. This is a test star for a 3 in. refractor--if you can see it even as a notched double, you have a good telescope.
Place: 22h 27m 0.2 deg. South

TAU-one in Aquarius is a double star mag 5.7 white and mag 9.2 pale red. The separation is 26 sec. of arc. Not easy even with the wide spread.
Place: 22h 46m 14.2 deg. South

TAU-two in Aquarius is a pretty orange star, mag 4.2. With Tau-one it makes a fine binocular pair with a separation of .7 degree.
Place: 22h 48m 13.7 deg. South

NO. 94 AQUARIUS is double with reddish-white primary mag 5.3 and companion mag 7.3 light blue at 13 seconds of arc.
Place: 23h 18m 13.6 deg. South

NO. 107 in Aquarius is double, component A mag 5.4 white, B mag 5.7 blue. The separation is 7 sec. of arc.
Place: 23h 44m 18.8 deg. South

STAR NAMES MAP 2

ACHERNER	AKE-er-nar	PHOENIX
ALGENIB	al-JEE-nib	PEGASUS
AL NAIR	aL-NAY-ir	GRUS
ALPHERATZ	aL-FEE-rats	ANDR.
ANKAA	ank-KAY-uh	PHOENIX
CAPH	kaff	CASSIOPEIA
DENEB	DEN-ebb	CYGNUS
DIPDA	DIP-dah	CETUS
ENIF	ENN-if	PEGASUS
FOMALHAUT	FOAM-al-ought	PSC. AUS.
MARKAB	MAR-kab	PEGASUS
MIRAK	MY-rack	ANDR.
PEACOCK	PEE-cock	PAVO
SADR	SAD-der	CYGNUS
SCHEAT	SHEE-at	PEGASUS
SCHEDIR	SHED-durr	CASS.

selected SKY OBJECTS MAP 3

NO. 19 PISCES is a red variable with a short range from mag 6.7 to 7.7, meaning it is bright enough anytime for a good view. The color is excellent.
Place: 23h 45m 3.3 deg. North

NGC 7789 is an open cluster in Cassiopeia showing about 200 faint stars in a half-degree field. The stars average about mag 13, which means you need 6 in. or more aperture.
Place: 23h 56m 56.5 deg. North

PI, ANDROMEDA is a double showing a mag 4.5 white star with blue mag 8.5 companion at 36 seconds.
Place: 0h 35m 33.6 deg. North

M 31 is the Great Nebula in Andromeda, largest and brightest of the external galaxies despite the fact it is over 2 million light-years from earth. By comparison, Sirius at 9 light-years seems almost close. M31 can be seen naked-eye as a misty spot; it makes a bright ellipse in binoculars or small telescopes, but with no trace of the spiral arms or other details seen in photos.
Place: 0h 41m 41.1 deg. North

PSI-one in Pisces is a neat pair of silver-white stars separated by 30 sec. of arc. Mags 5.6 and 5.8. Easy to find and easy to see in any telescope.
Place: 1h 4m 21.3 deg. North

STAR NAMES	MAP 3	
ACAMAR	AKE-uh-mar	ERID
ACHERNAR	AKE-er-nar	ERID
ALDEBARAN	al-DEB-uh-ran	TAUR
ALGOL	AL-gol (LIKE GOLLY!)	PERS
ALMAK	al-MAK	ANDR
ALNILAM	al-nih-LAM	ORION
ALNITAK	al-nih-TAK	ORION
AL RISHA	al-RISH-uh	PISCES
ARNEB	ARE-neb	LEPUS
BELLATRIX	bell-LAY-trix	ORION
BETELGEUSE	BETT-el-jeuse (JUZZ)	ORION
CAPELLA	kah-PELL-uh	AURIGA
ELNATH	el-NATH	TAURUS
HAMAL	HAM-al	ARIES
MENKALINAN	men-KAL-ih-nan	AURI
MENKAR	MEN-kar	CETUS
MINTAKA	min-TAK-uh	ORION
MIRA	MY-ruh	CETUS
MIRAK	MY-rack	ANDROM
MIRFAK	MURR-fak	PERSEUS
PHACT	fact	COLUMBA
RIGEL	RYE-jell	ORION
SAIPH	safe	ORION
SHERATAN	SHAIR-uh-tan	ARIES

M 33 is an external galaxy of the spiral type marvelously photogenic but hardly more than a gray cloud in a small telescope--you can go right over it without ever knowing you were there. Size, about 40x60' of arc; needs at least 10 in. aperture.
Place: 1h 32m 30.5 deg. North

GAMMA, ARIES. Double. A matching pair of white stars, mags 4.2 and 4.4 spread 9 sec. of arc.
Place: 1h 52m 19.2 deg. North

LAMBDA, ARIES is a wide double, mags 4.8 yellowish and 7.6 blue separated by 37 seconds.
Place: 1h 56m 23.5 deg. North

NGC 752 is a very open open cluster in Andromeda showing about 70 stars. Rated about 45' dia. in the Skalnate Pleso catalog, but with rich fringe easily fills a 1 deg. field.
Place: 1h 56m 37.5 deg. North

AL RISHA is the alpha star in Pisces. A close pair of bluish-white stars mags 4.3 and 5.3. Closing slowly from 3.1" in 1880 to 2" in 1940. Currently just 1.8 sec. of arc between the stars, closing to 1.5" in the year 2000.
Place: 2h 0m 2.6 deg. North

ALMAK, Andromeda is a popular double mentioned in all lists. Mags 2.3 orange and 5.1 blue at 10 seconds of arc. Nice color contrast.
Place: 2h 2m 42.2 deg. North

MIRA--The Wonderful--in Cetus is a yellow variable with an amazing brightness range from mag 2 to an out-of-sight mag 10. The period is about 332 days. Worth study if you go for variables, and always worth a look if you are curious--"What's Mira doing tonight?"
Place: 2h 18m 3.1 deg. South

The DOUBLE CLUSTER. ERECT VIEW LOOKING NORTH. NO. 884 IS AT RIGHT (EAST)

NGC 869-884 is the well-known Double Cluster in Perseus, visible to the naked eye on a clear night and a grand sight in binoculars. Each cluster is about 50' dia. and the same distance apart, so the whole thing is about 1.7 deg. wide and a little too big for an "all at once" view in a telescope.
Place: 2h 19m 57.0 deg. North

FLAMSTEED No. 30 in Aries is a double star, mags 6.2 yellow and 7.2 blue in a 39-sec. spread. This is an optical pair, that is two stars which happen to be in the same line of sight, but not otherwise related.
Place: 2h 35m 24.5 deg. North

M 34 CLUSTER in Perseus displays about 80 stars in a 30' field.
Place: 2h 40m 42.7 deg. North

M 77 in Cetus is a spiral galaxy about 2 x 2.5 min. of arc in size, shining at about mag 9. Like all such objects, dim and difficult because it is millions and millions of miles from your telescope. You can see it, even in a 3 in. refractor, but only as a hazy spot of light without detail.
Place: 2h 41m 0.2 deg. South

ETA, PERSEUS is double, mags 4.8 and 8.5 separated by 28 sec. of arc. Eta is the first bright star following (to the east of) the Double Cluster. Many faint stars provide a sparkling background.
Place: 2h 49m 55.8 deg. North

ALGOL in Perseus is the most popular of all variable stars. This is a binary of the dark-eclipsing type where the bright primary is more or less eclipsed by the dark companion. The period is about 3 days, of which more than 2 days show the "demon" star a stable mag 2.3 near full maximum. The rise from minima (3.7) to maxima (2.0) takes about 5 hrs. For many years Sky and Telescope magazine has published the complete timetable of this interesting object.
Place: 3h 6m 40.8 deg. North

MIRFAK, PERSEUS of mag 1.9 is

easy to find and always worth a look-around because the area is rich in faint stars.
Place: 3h 22m 49.8 deg. North

PLEIADES in Taurus is an open cluster on a big scale--at 40x you can just catch the main stars in a 1.2 deg. field. Altogether about 130 bright stars can be seen in a small telescope. The "light of the Pleiades" is Alcyone, shining at mag 3--it has two mag 8 companions at 120 seconds, but you will probably see only one.
Alcyone: 3h 46m 24.0 deg. North

No. 32 ERIDANUS is double, showing a mag 5.0 yellow and a mag 6.3 greenish-blue standing 7" apart.
Place: 3h 53m 3.1 deg. South

NGC 1535 is a bluish planetary neb in Eridanus. Rated about mag 11, 18 sec. of arc diameter. Like all planetaries, it is just a hazy dot in the sky--don't bother unless you have at least 8 in. aperture.
Place: 4h 13m 12.8 deg. South

THE HYADES is a bright cluster in a 7x50 binocular. Included are two naked-eye doubles: Theta, mag 3.6 white and 4.0 yellow, spread 5-1/2 min. of arc, all of which is declination. Sigma is also a 5.5' spread showing two white stars, mags 4.9 and 5.2.
Theta: 4h 27m 15.8 deg. North
Sigma: 4h 38m 15.8 deg. North

R, LEPUS is a red variable with a range from mag 5.5 to 10.7 which it does in 436 days. This is Hind's celebrated crimson star, of which he said: "Of the most intense crimson, resembling a drop of blood on the black ground of the sky."
Place: 4h 58m 18.9 deg. Soutn

NO. 14, AURIGA is a double mags 5.4 pale yellow and 7.5 orange at an easy spacing of 14 sec. of arc.
Place: 5h 13m 32.7 deg. North

No. 23, ORION is the top star in a small cross along the west edge of Orion. It is a white double, mags 5.0 and 7.1 with a comfortable spread of 32 sec. of arc.
Place: 5h 21m 3.5 deg. North

M 1 in Taurus is the Crab Nebula. Comet-hunter Messier noted this as "a whitish light, elongated like the flame of a taper." This looked something like a comet, and caused him to start his now-famous list of objects which are not comets. M 1 is a planetary, rated about mag 10, 4 x 6-min. of arc in angular size which is larger than most. It is actually the remains of an exploded star, seen and recorded by the Chinese in the year 1054. You can see this object with binoculars, but you need at least 8 in. aperture to pick up any of the detail in the crab-like figure shown in photos.
Place: 5h 33m 22.0 deg. North

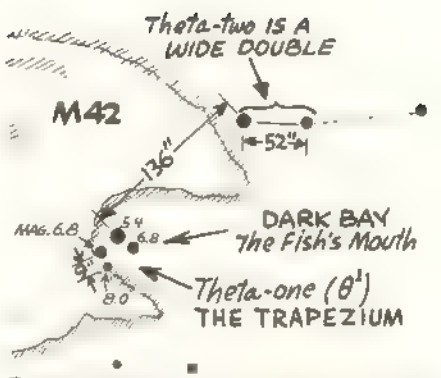
LAMBDA in Orion. This is the top star of three in the head of Orion. It is a neat double of white stars, mags 4 and 6, fairly close at 4-1/2 sec. of arc, which means you need 80 to 100x for a comfortable split.
Place: 5h 33m 9.9 deg. North

THETA-ONE in Orion is the finest multiple star for small telescopes. It shows 4 stars to a 2 or 3-in. refractor at 40x, this group being well-known as The Trapezium. In the same field you can see Theta-two which is a wide double, the whole display on the greenish background of the bright diffuse nebula, M42.
Place: 5h 34m 5.4 deg. South

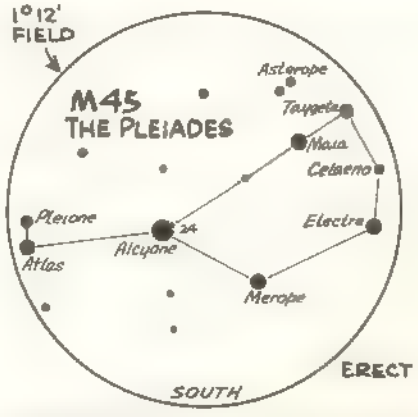
GAMMA, LEPUS is a wide double showing a yellow primary of mag 3.8 with a reddish companion mag 6.5 at 95 sec. of arc. A mag 13 red star may be visible.
Place: 5h 43m 22.5 deg. South

SIGMA, ORION is a multiple star showing as many as 10 stars in large telescopes, but the usual view with 3 to 6-in. aperture is a quad. Components A and B are very close at .3" and are usually seen as one star of about mag 4. Component C is mag 10.3, 11" from AB. Component D is mag 7.5 and is 13" from AB. Star E is mag 6.3 and is a wide 42 sec. of arc from AB.
Place: 5h 37m 2.6 deg. South

M 37 is the biggest and brightest of three nice clusters in Auriga--it shows about 150 stars in a 25' field. M 38 has about 100 stars in a 20' field. M 36 is a compact bundle of 60 stars, nearly as bright as M37 but only 12' diameter.
M 36: 5h 33m 34.1 deg. North
M 37: 5h 49m 32.5 deg. North
M 38: 5h 25m 35.8 deg. North



The TRAPEZIUM IS SEEN PLAINLY IN 6-inch AT 50x. THIS VIEW IS INVERTED as in TELESCOPE... it SHOWS ONLY ABOUT 1/10 OF FIELD YOU SEE at 50x

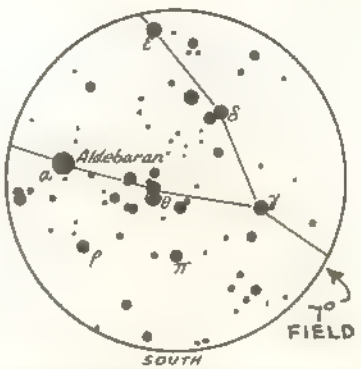


The PLEIADES - WELL-KNOWN OPEN CLUSTER MAKES A PRETTY PICTURE at 50x

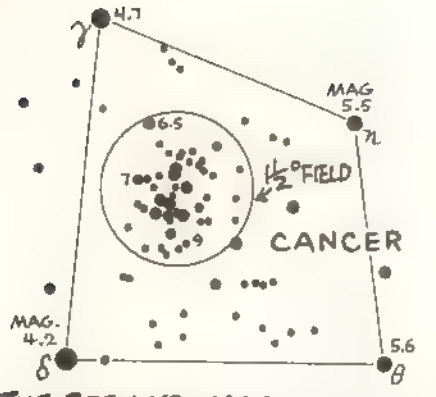
THE PLEIADES *(PLEE-uh-deez)*

SEVEN SISTERS		
	ALCYONE... *al-SIGH-oh-nee*	3.0
	ASTEROPE.. *as-TAIR-oh-pee*	5.9
	CELAENO... *seh-LEE-noe*	5.4
	ELECTRA.... *eh-LEK-tra*	3.8
	MAIA..... *MY-uh*	4.0
	MEROPE... *MARE-oh-pee*	4.3
	TAYGETA... *tah-IJ-ah-tah*	4.4
	PLEIONE.. *plee-OH-nee*	5.1
	ATLAS..... *AT-lus*	3.8

PLEIONE IS MAMA AND ATLAS IS PAPA. STAR № 24 (MAG 8) MAKES A WIDE DOUBLE WITH ALCYONE AT 117 SECONDS



THE HYADES - ERECT VIEW AS SEEN WITH 7x BINOCULAR (7° FIELD)



THE BEEHIVE—M44 NEEDS LOW POWER TO COVER 1½° FIELD...a 1¼" Erfle eyepiece at 38× will do it

selected SKY OBJECTS

MAP 4

M35 is an open cluster showing about 120 stars, the whole rated mag 5.3 in the Skalnate Pleso catalog. About 40' field makes a nice view at 60 to 90x.
Place: 6h 7m 24.3 deg. North

BETA, MONOCEROS is a fine triple star of mags 4.6, 5.2 and 5.4 spread in a slim triangle with separations of 10" maximum and 2.7" minimum. A 6 in. reflector at 180x will show the three yellow-white stars in a comfortable spread.
Place: 6h 27m 7.0 deg. South

NGC 2244 cluster contains only about 16 stars but they are bright including several of 7th magnitude. "Beautiful!"--Webb. (Celestial Objects for Common Telescopes).
Place: 6h 31m 4.8 deg. North

STAR NAMES Map 4

ADHARA	CANIS MAJOR	add-DARE-rah
ALGEIBA	LEO	al-GEE-buh
ALHENA	GEMINI	al-HEN-uh
ALPHARD	HYDRA	AL-fard
AVIOR	CARINA	A-vee-or
CANOPUS	CARINA	can-OH-puss
CASTOR	GEMINI	CASS-ter
MIRZAM	CANIS MAJOR	MURR-zam
POLLUX	GEMINI	POLL-lux
PROCYON	CANIS MINOR	PRO-see-on
REGOR	VELA	REE-gor
REGULUS	LEO	REG-you-luss
SIRIUS	CANIS MAJOR	SEER-ee-us
SUHAIL	VELA	SUE-hail
WASAT	GEMINI	WAY-sat
WESEN	CANIS MAJOR	WESS-en

SEE MAP 3 and LIST for OBJECTS BETWEEN 5 hr. and 6 hr. RIGHT ASCENSION

UU, AURIGA is a long-period variable but its main appeal to stargazers is its beautiful red color.
Place: 6h 34m 38.5 deg. North

NGC 2264 is a modest cluster in Monoceros showing about 20 stars in a 30'field. It includes Flamsteed No. 15, which is a pair of mag 4.7 stars 2.9 seconds apart. No. 15 is also a red variable and is often labeled S for this feature.
Place: 6h 40m 10.0 deg. North

NO. 12, LYNX is a triple star, mags 5.2, 6.1 and 7.4 with least separation of 1.7 sec. and widest at 9 seconds. You can split it with a 6-in. reflector. Only double in 3-in. refractor.
Place: 6h 44m 59.4 deg. North

SIRIUS--the Dog Star--always gets a look just because it is the brightest of all stars. It is actually a double with a mag 8 companion at 11 seconds. This sounds easy but you soon find the companion star is lost in the glare of the primary. About 300x with 8 in. aperture will split it if seeing is good.
Place: 6h 44m 16.7 deg. South

M 41 CLUSTER. After looking at bright Sirius it is easy to drop down 4 degrees and then wait a couple minutes until M 41 comes sailing into view. It shows about 50 stars bunched in groups in a 30' field.
Place: 6h 46m 20.7 deg. South

M 50. Open cluster in Monoceros shows over 100 stars in a 15' field but only a few as bright as mag 9.
Place: 7h 2m 8.3 deg. South

NGC 2392 is an oval planetary nebula about 40 sec. dia. showing a central star of 8th magnitude.
Place: 7h 27m 21.0 deg. North

CASTOR in Gemini was once a fairly easy double with separation of 5 sec. of arc in 1925. This closed to 4 sec. in 1940 and is currently (1970) down to 2 seconds and will continue to close slowly for many years. Both stars bluish-white, mags 2.0 and 2.9. There is a third star, mag 9.5 at 72 sec. which may show in a 3-in. refractor.
Place: 7h 33m 32.0 deg. North

M 46 in Puppis shows a cluster of about 150 stars from 9th to 13th magnitude. About 25' field is dotted on northern edge with planetary NGC 2438, this only about 1' diameter and faint at 12th magnitude.
Place: 7h 41m 14.8 deg. South

M 93 is a cluster in Puppis showing about 60 stars in a 25' field.
Place: 7h 44m 23.8 deg. South

NGC 2539 is a cluster in Puppis showing about 150 stars including Flamsteed No. 19 mag 5 in a 25' field.
Place: 8h 9m 12.8 deg. South

ZETA, CANCER is a typical "big telescope" triple, meaning it has an easy spread of 5 seconds and another separation not so easy at 1 second. All three stars are bright at mags 5.1, 5.7 and 5.5. The close pair is a binary with period of 60 years, widest at 1.2 sec. (1960), closing to .7 sec. about 1990.
Place: 8h 10m 17.7 deg. North

THE BEEHIVE, M 44, is a popular wide-field open cluster--you may have to use your finder to catch all of it.
Place: 8h 38m 20.1 deg. North

IOTA, CANCER is a pale yellow and bright blue double star, the yellow primary being mag 4.2 and the blue companion mag 6.6. The spread of 30" is easy in any telescope.
Place: 8h 45m 28.9 deg. North

M 67 is an open cluster below the popular Beehive. Compared to the Beehive it is small at 15' but packs about 65 stars in this area, the whole rated about mag 6.
Place: 8h 50m 11.0 deg. North

NO. 38, LYNX is a close double of 3 seconds showing mags 4.0 and 5.9 stars.
Place: 9h 17m 36.9 deg. North

TAU-one, HYDRA is a wide double with white primary mag 4.6 and a lilac mag 7.2 companion, spread 66" of arc.
Place: 9h 28m 2.6 deg. South

ALGEIBA in the Sickle is a popular double star mags 2.6 and 3.8, both yellow. Separation of 4.7 sec. is easy to split with 100x. This is a binary with a period of 619 years, which means you don't have to worry about the separation changing real fast.
Place: 10h 18m 20.0 deg. North

selected SKY OBJECTS

MAP 5

NGC 3242. Planetary neb in Hydra. 35 x 40 sec. showing a pale blue disk in 3 in. at 100x. Better with larger telescope.
Place: 10h 23m 18.5 deg. South

TAU, LEO is a yellow and blue double of mags 5.2 and 7.0 spread 90 seconds of arc.
Place: 11h 26m 3.0 deg. North

NGC 4361. A large but faint planetary inside the sail of Corvus. About 80 sec. dia., rated mag 10 visually.
Place: 12h 23m 18.6 deg. South

SS, VIRGO is a variable star ranging from mag 5.9 to mag 10.0. Notable for its deep red tint.
Place: 12h 24m 0.9 deg. North

NO. 17, COMA BERENICES is a double of mag 5.4 white and mag 6.7 lilac. Very wide at 145 seconds. No. 17 is one of a nice binocular group below Gamma, the whole commonly described as Berenice's Hair, which name is also applied to the whole constellation.
Place: 12h 27m 26.1 deg. North

DELTA, CORVUS is a double star with combined magnitude of 3.0 making a skymark triangle with Spica and Porrima in Virgo. The primary is a mag 3.1 yellow star, while the red-purple companion is mag 8.6 comfortably spaced at 24 seconds.
Place: 12h 28m 16.4 deg. South

NO. 24, COMA BERENICES is a 20-sec. double of good brilliance and color contrast showing a mag. 5.5 orange and 7.0 emerald star.
Place: 12h 33m 18.5 deg. North

M104 was added to Messier's original list by his colleague Pierre Mechain. This is a spiral galaxy in Virgo 2' x 7' in angular size seen nearly edgewise. A small telescope will show only a hazy disk but 8 in. or larger aperture working at 200x reveals why it is called the Sombrero nebula.
Place: 12h 38m 11.5 deg. South

PORRIMA in Virgo is one of the classical double stars of known orbit and separation. Its orbit takes 172 years. Currently the separation is 4.5 seconds but the distance is closing and will be under 2 seconds by the year 2000. The two stars are evenly matched at mags 3.6 and 3.7, both yellow-white.
Place: 12h 40m 1.3 deg. South

Y, CANES VENATICI is a variable star but best-known for its deep red-orange color.
Place: 12h 44m 45.6 deg. North

COR CAROLI is the brightest star in Canes Venatici and is an easy 20-sec. double of mags 3.2 and 5.7 blue-white stars.
Place: 12h 55m 38.5 deg. North

THETA, VIRGO is a double star with 9th magnitude companion separated by 7 seconds from the white primary of mag 4. There is also a mag 10 companion at 71 seconds.
Place: 13h 8m 5.4 deg. South

M 3 GLOBULAR in Canes Venatici is partly resolved with 6-inch aperture at 200x. About 10' of arc in diameter, magnitude about 6.
Place: 13h 41m 28.5 deg. North

PI, BOOTES is a 6-sec. double mags. 4.9 and 5.8 spaced 6 sec. apart.
Place: 14h 39m 16.5 deg. North

IZAR, BOOTES is a good-contrast double showing a mag. 2.7 yellow-orange star and a mag 5.1 blue. Only 2.8 seconds separation--good test for 3-inch.
Place: 14h 44m 27.2 deg. North

ZUBENELGENUBI is the alpha star in Libra. It is a very wide double mag 2.9 with mag 5.3 white companion at 230 seconds.
Place: 14h 49m 15.9 deg. South

MU, LIBRA is a test double for your 3-in. with separation of 1.6 sec. The two stars rate mag 5.8 and mag 6.7, with total brightness about mag 5.4.
Place: 14h 48m 14.0 deg. South

XI, BOOTES is a double star standing about 8.5 deg. east from Arcturus. The stars are mag 4.8 yellow and 6.8 red spaced 7 sec. apart. This is a true binary with period of 150 years. The maximum separation of 7.2 seconds of arc will occur in 1977.
Place: 14h 50m 19.2 deg. North

IOTA, LIBRA consists of Flamsteed stars Nos. 24 and 25 which form a wide double at 58 seconds. The primary star is mag 4.7 pale yellow with mag 9.7 red-purple companion. The companion itself is a double, being a pair of 10th magnitude stars spread 1.8 sec. apart.
Place: 15h 11m 19.7 deg. South

DELTA, BOOTES is a wide double at 105 sec. and can be split with 7x binock. Colors light yellow and lt. blue, mags 3.5 and 7.4.
Place: 15h 14m 33.4 deg. North

NGC 5897. Globular cluster in Libra. 7' dia. but faint at mag 10. With care you will find it 12 deg. due South of Zubeneschamali.
Place: 15h 16m 20.9 deg. South

M 5 is a bright globular in Serpens. Size about 20' or a little over one-half of a moon. Mag 6 is much compressed at center, i.e., a blaze at center. Easy to pick up in any telescope but needs at least 8 in. aperture for a good view. Close-by is Flamsteed No. 5 which makes finding easy.
Place: 15h 17m 2.2 deg. North

NO. 5 SERPENS is one of the marginal stragglers of M 5. This is a delicate double of mags 5.3 yellow and 10.5 pale white, made difficult by the faintness of the companion. Separation, 13 sec.
Place: 15h 18m 1.9 deg. North

MU, BOOTES is an easy double at 108 seconds of arc separation, the stars being mag 4.5 and mag 6.7. The dimmer star is itself a binary of mags 7.0 and 7.6, but close at 2 seconds and needs at least 100x for a notched split.
Place: 15h 23m 37.5 deg. North

STAR NAMES *Map 5*

ALGEIBA	al-JEE-buh	LEO
ARCTURUS	ark-TOO-rus	BOOTES
COR CAROLI	kor-KAY-ro-lie	CANES VENATICI
DENEBOLA	de-NEB-oh-la	LEO
GIENA	JEEN-uh	CORVUS
HADAR	HAD-er	CENTAURUS
IZAR	EYE-zar	BOOTES
MUHLIFAIN	MULL-uh-fain	CENTAURUS
NEKKAR	NECK-ker	BOOTES
PORRIMA	PORR-uh-mah	VIRGO
REGULUS	REG-you-lus	LEO
SPICA	SPY-ka	VIRGO
VINDEMIATRIX	vin-dee-MY-uh-trix	VIRGO
ZUBENELGENUBI	zoo-ben-ell-jen-NEW-bee	LIBRA
ZUBENESCHAMALI	zoo-ben-ess-sha-MAY-lee	LIBRA

selected SKY OBJECTS

MAP 6

DELTA, SERPENS. A double showing two white stars mags 4.2 and 5.2 separated by 4 seconds of arc. You will need at least 100x for a comfortable split.
Place: 15th 33m 10.6 deg. North

ZETA, CORONA Borealis is a pretty optical double showing a blue-white star mag 5.1 and a blue one, mag 6.0 at 6 seconds.
Place: 15h 38m 36.7 deg. North

BETA, SCORPIUS is a blue-white pair spread 14 sec. apart, mags 2.9 and 5.1. There is also a 10th magnitude companion but at .8-sec. it is lost in the glare of the primary.
Place: 16h 4m 19.7 deg. South

NU-ONE and Nu-Two in Corona B. forms a wide double of mag 5 yellow stars spaced about 370" apart. The separation of more than 6 min. of arc is extremely wide for a telescope double, yet it is only about 1/12 of the field at 40x.
Place: 16h 21m 33.8 deg. North

M4 GLOBULAR cluster is right next door to Antares, so after viewing the red giant you can move over a little to the west . . . and there's your globular. It has size to be seen at 14 min. of arc but shows only a granular disk to a 3 in. refractor.
Place: 16h 22m 26.5 deg. South

ANTARES is a popular object to look at just because it is big, bright and red. It is actually a 3-second double with a green 7th mag companion, which sounds fairly easy but actually needs at least a 10-in. to show. In some early star lists mag 1.2 Antares is described as having a green flare at one side, and that is about the best you can do with a 6-in. reflector.
Place: 16h 28m 26.4 deg. South

M 13 is the Great Cluster in Hercules and the best-known of the globulars. The big ball of stars is partly resolved in a 6-in. reflector at 150x, but it needs 10-in. aperture or larger for a really good view of the thousands of faint stars averaging mag 13.5.
Place: 16h 41m 36.5 deg. North

M 10 is a globular cluster in Ophiuchus easily visible in the smallest telescope but not resolved. It is about 8 min. diameter. Nearby M 12 is similar.
Place: 16h 56m 4.1 deg. South

RASALGETI is the alpha star of Hercules and a fine double, the primary being mag 3.5 orange with a blue-green companion mag 5.5, the two fairly close at 4.5 sec. of arc. The colors are strong, easy to see without guessing. You will need 100x for a comfortable split.
Place: 17h 13m 14.4 deg. North

M 6 OPEN CLUSTER in Scorpius. This is about 25' diameter and shows about 50 fairly bright stars, the whole thing rated about mag 5.5 visually, meaning you can pick it up as a faint glow with binoculars. Good view in 6-in. reflector at 40 to 100x.
Place: 17th 38m 32.2 deg. South

M 7 OPEN CLUSTER is about 1 deg. diameter and is bigger and brighter than nearby M 6. Fine view with a 3-in. refractor at 40x.
Place: 17h 52m 34.8 deg. South

M 23 OPEN CLUSTER in Sagittarius. About 120 faint stars including one mag 7 near the edge of 30' field.
Place: 17h 55m 19.0 deg. South

NO. 95, HERCULES is a 6-second pair which splits easily at 100x showing a greenish and red-yellow star.
Place: 18h Om 21.8 deg. North

M 8--LAGOON Nebula includes a star cluster and a bright diffuse nebula. View this in the fall of the year to get the "black velvet" sky needed to show the nebulosity surrounding the stars. It takes low power to see it all in one view--a 1-1/4-in. Erfle eyepiece is fine.
Place: 18h 2m 24.3 deg. South

M 21 OPEN CLUSTER shows about 50 stars in a 12' field.
Place: 18h 3m 22.5 deg. South

NO. 70, OPHIUCHUS is a close double showing a yellow primary of mag 4.3 and red-orange companion of mag 6.0. This is one of the many binary systems which have been observed for many years. The separation is currently (1973) close to a minimum, being about 2 seconds and it will get a little closer before it spreads to a comfortable 4 seconds in the year 2000. The whole orbit takes 88 years.
Place: 18h 4m 2.5 deg. North

M 24 OPEN CLUSTER is a tight pack of about 50 stars in a 4 minute field. Good at high power.
Place: 18h 17m 18.4 deg. South

M 16 OPEN CLUSTER in Serpens. 25' field shows about 55 stars on a luminous background.
Place: 18h 17m 13.8 deg. South

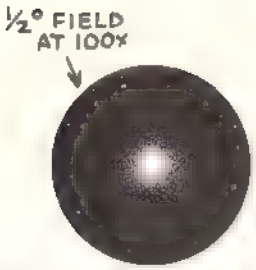
M 17 is a bright diffuse nebula usually called the Omega or Horseshoe nebula although it looks more like a long checkmark than a horseshoe. M 17 was discovered by Messier in 1764 and described by him as a train of light without stars. However, photos show 25 or 30 stars in the area. Size about 30 x 50-min. of arc.
Place: 18h 19m 16.3 deg. South

M 22 GLOBULAR CLUSTER has a diameter of about 17' which is half as big as the moon. Individual stars can be seen with a 6-in. reflector working at 150x.
Place: 18h 35m 23.9 deg. South

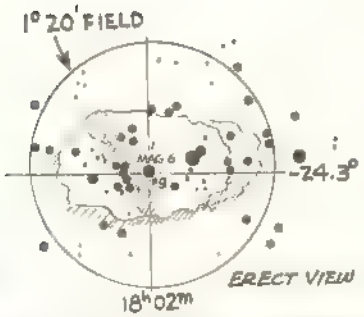
EPSILON, LYRA is the popular double-double. You may be able to see this naked-eye as a wide pair. Each star of the wide pair is a double, but now the separation is a mere 2 sec. and you will need about 200x for a clean split without notching.
Place: 18h 43m 39.6 deg. North

STAR NAMES *Map6*

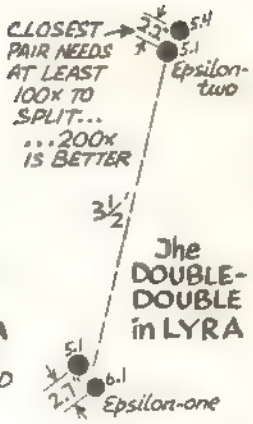
ALBIREO	*al-BURR-ee-oh*	CYGNUS
ALPHECCA	*al-FECK-uh* also GEMMA, brightest "gem" in crown	CORONA BOR.
ALSHAIN	*al-SHANE*	AQUILA
ALTAIR	*al-TAIR*	AQUILA
ANTARES	*an-TAIR-eez*	SCORPIUS
ARKAB	*ARE-kab*	SAGITTARIUS
DSCHUBBA	*JUBB-a*	SCORPIUS
ELTANIN	*el-TAY-nin*	DRACO
KAUS AUSTRALIS	*KOSS oss-TRAY-liss*	Sagr.
NUNKI	*NUN-kee*	SAGITTARIUS
RASALGETI	*RAS-el-getty*	OPHIUCHUS
RASALHAGUE	*RAS-el-haig*	OPHIUCHUS
SABIK	*SAY-bik*	OPHIUCHUS
SADR	*like "sadder"*	CYGNUS
SHAULA	*SHAW-lah*	SAGITTARIUS
TARAZED	*TAR-uh-zed*	AQUILA
UNUK	*YOU-nuk*	SERPENS
VEGA	*VEE-guh*	LYRA



M13 – THE GREAT CLUSTER IN HERCULES. BLAZE AT CENTER IS EASY TO SEE *BUT* 6" ONLY BEGINS TO RESOLVE THE FAINT OUTER STARS



M8 – THE LAGOON NEBULA IS A FINE OBJECT ON A DARK NIGHT. *LOW POWER IS NEEDED TO COVER THE BIG FIELD*



M6 OPEN CLUSTER SHOWS A FIELD FULL OF STARS IN EITHER A 3" REFRACTOR OR 6" REFLECTOR WORKING AT 120×

ZETA, LYRA is an easy double showing a reddish mag 4.3 star and a fainter blue-green mag 5.9 separated by 44 seconds. You can split this with 7x binocular, but a telescope at 40x is better.
Place: 18h 44m 37.6 deg. North

BETA, LYRA is a bright eclipsing variable star ranging from mag 4 to mag 5 with a period of 13 days. The star is also a triplet with a mag 7.8 companion at 47 sec. and another mag 8.5 at 66 seconds.
Place: 18h 49m 33.3 deg. North

M 11 in Scutum is a fan-shaped open cluster of about 200 stars in a 15' field. Bright enough to be seen with binoculars but only as a misty patch --3 in. or more aperture gives the needed resolution and light pickup. A real sparkler!
Place: 18h 50m 6.3 deg. South

M 57 RING NEBULA looks like a big smoke ring in the sky. It is not impressive in a small telescope but even a 3-in. at 120x will show the central hole.
Place: 18h 53m 33.0 deg. North

THETA, SERPENS is the tail of the serpent comprising two yellow stars mags 4.5 and 5.4 separated by 23 sec. It is a short hop west and south of Altair and easy to see at 40x.
Place: 18h 55m 4.2 deg. North

ALPHA, VULPECULA consists of Flamsteed Nos. 6 and 8. No. 6 is the brighter at mag 4 while the companion is mag 6 and very wide at 404 seconds.
Place: 19h 27m 24.6 deg. North

ALBIREO shows a 3.2 orange and 5.5 blue, wide-spaced at 35 seconds. You are not a star-gazer if you haven't seen this popular double.
Place: 19h 30m 27.9 deg. North

NGC 6819 open cluster in Cygnus is only about 6' in size but packs 150 stars from mag 10 to mag 15. This is easy to find being 8 deg. due west from Sadr in the Northern Cross.
Place: 19h 40m 40.2 deg. North

NO. 16, CYGNUS is a pretty double of mags 6.3 and 6.4 at 38 seconds.
Place: 19h 41m 50.5 deg. North

NO. 57, AQUILA is a neat double of mags 5.7 and 6.5 separated by 36 sec. Both stars are bluish. You can find this by dropping 17 deg. straight down from Altair.
Place: 19h 53m 8.3 deg. South

DUMBBELL NEBULA in Vulpecula is labeled M 27 or NGC 6853. It is bigger than most other planetaries, measuring 4' x 8' in angular size.
Place: 19h 58m 35.7 deg. North

OMICRON 1 and 2 in Cygnus forms a quadruple star but the faintest star of the four is a mere mag 13 at 34 sec., so it is more accurately described for small telescopes as a wide triple. Omicron-two is the primary star mag 3.9, while component D is Omicron-one 338 seconds. Component C of 7th magnitude is 107 sec. from the primary, the whole forming a triangle of which the primary is orange and C and D blue.
Place: 20h 13m 46.7 deg. North

ALPHA 1 and 2 in Capricornus mags 4.5 and 3.8 show as a yellow pair 6 min. apart. Very pretty in binoculars.
Place: 20h 16m 12.6 deg. South

GAMMA, DELPHINUS is a double of mag 4 yellow and mag 5 green, spread 10 sec. apart.
Place: 20h 45m 16.0 deg. North

ANGULAR FIELD of a TELESCOPE at VARIOUS MAGNIFICATIONS

MINUTES OF ARC

	APPARENT FIELD of EYPC.	MAGNIFICATION																		
		30×	40×	50×	60×	70×	80×	90×	100×	110×	120×	130×	140×	150×	175×	200×	225×	250×	275×	300×
ERFLE KELLNER AND ORTHOSCOPIC	60° =3600'	120'	90'	72'	60'	51'	45'	40'	36'	33'	30'	28'	26'	24'	21'	18'	16'	14'	13'	12'
	50° =3000'	100'	75'	60'	50'	43'	37'	33'	30'	27'	25'	23'	21'	20'	17'	15'	13'	12'	11'	10'
HUYGENS and RAMSDEN	40° =2400'	80'	60'	48'	40'	34'	30'	27'	24'	22'	20'	18'	17'	16'	14'	12'	11'	10'	9'	8'

General Formula: $TF = \frac{AF}{M}$ (TF = TRUE FIELD; AF = APPARENT FIELD (FIELD OF EYPC.); M = MAGNIFICATION)

Example: WHAT IS TOP POWER YOU CAN USE TO LOOK AT A STAR CLUSTER 26' DIAMETER? *ASSUME 50° EYEPIECE*

Solution: RUN YOUR EYE ALONG 50° EYEPIECE LINE. *READ 27', WHICH IS OK for SIZE. Then, read 110× in top line*

how to use this map

Face north. Turn the map to put the current date at top. Directly opposite the date on the Right Ascension scale, read the R.A. hour on your meridian at 8 o'clock mean time (or the equivalent standard time or daylight time). Reading the scale to the nearest 5-min. mark is usually accurate enough.

When you face north and put the date at the top, the stars on the map are in the same position as you see them naked eye in the sky. The bottom edge of map is your north horizon; the top part of the map shows stars from Polaris southward to your zenith (nearly). It is helpful to hold the map erect to get the whole picture of how the map coincides with the sky itself.

If the time is later than 8 o'clock (or the equivalent standard or daylight time), you determine the amount of time you are past map time and add this to the R.A. reading. An example is shown below. This also compares working with mean time and daylight time. The advantage of mean time is that you start out with a round figure--8:00--to which it is easy to add the elapsed time. The catch is that to use mean time you need a clock set to mean time. The best way is to use standard time. The poor feature is that the equivalent time is usually some odd figure--like 8:26--for the basic map time. Adding the elapsed time to this takes a little more effort. The elapsed time can also be counted on the R.A. scale itself--clockwise for a later time. Once you find the R.A. of the meridian, it applies to the whole sky as well as the circumpolar region shown on the map.

The segment equatorial maps which follow are used in the same way except you face south and the R.A. increases counterclockwise.

How to Find R.A. on your Meridian at any Time
Example IS FOR AN OBSERVER AT **Akron, Ohio** on **Oct. 6**

USING A CLOCK RUNNING ON L.M.T.:
OPPOSITE Date (Oct. 6)
READ.... 21:00 R.A.
THIS IS R.A. ON YOUR MERIDIAN AT 8:00 L.M.T.

for a later time, say 9:10 L.M.T.
YOU ARE 1h 10m LATER THAN MAP TIME... SO YOU ADD THIS TO R.A.
R.A. at 8:00 L.M.T.... 21:00
Plus Elapsed Time..... 1:10
22:10
THIS IS YOUR MERIDIAN at 9:10 L.M.T.

USING A CLOCK ON DAYLIGHT TIME:
OPPOSITE Date (OCT. 6)
READ..... 21:00 R.A.
THIS IS R.A. ON YOUR MERIDIAN at 9:26 E.D.T.

for a later time, say 10:36 E.D.T.
YOU ARE 1h 10m LATER THAN MAP TIME... SO YOU ADD THIS TO R.A.
R.A. at 9:26.... 21:00
Plus Elapsed Time.... 1:10
22:10 R.A.
ELAPSED TIME 10:36 less 9:26 = 1h 10m
THIS IS YOUR MERIDIAN AT 10:36 E.D.T.

STAR MAGNITUDES:

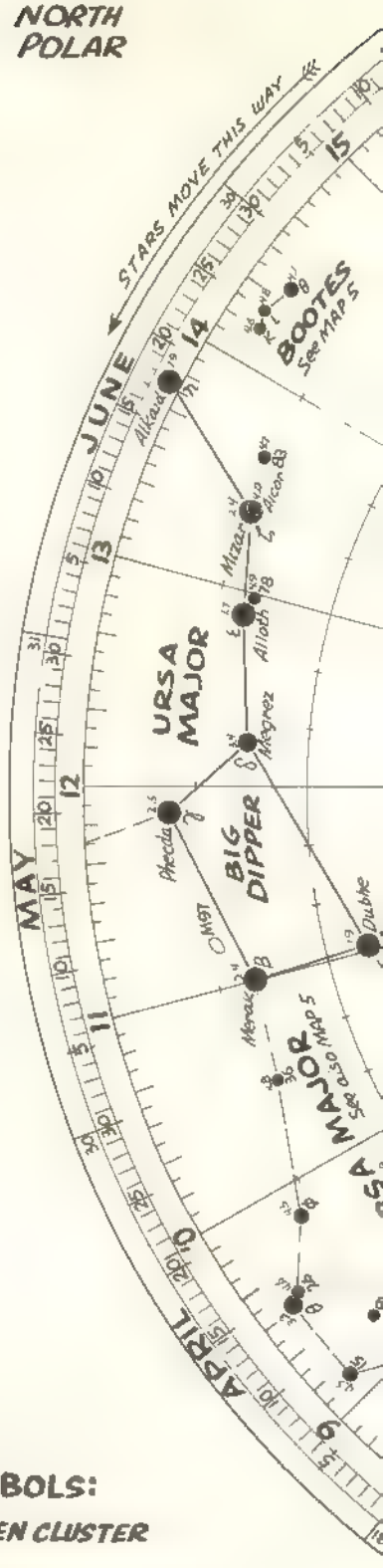
The EXACT MAGNITUDE of EACH STAR IS MARKED ON THE MAP

MAGNITUDE	0	1	2	3	4	5	6
	0.5 OR BRIGHTER	0.6 to 1.5	1.6 to 2.5	2.6 to 3.5	3.6 to 4.5	4.6 to 5.5	5.6 or fainter
						MAP SHOWS only to MAG 5.0	ONLY a FEW MAG 6 shown

STAR DESIGNATIONS:

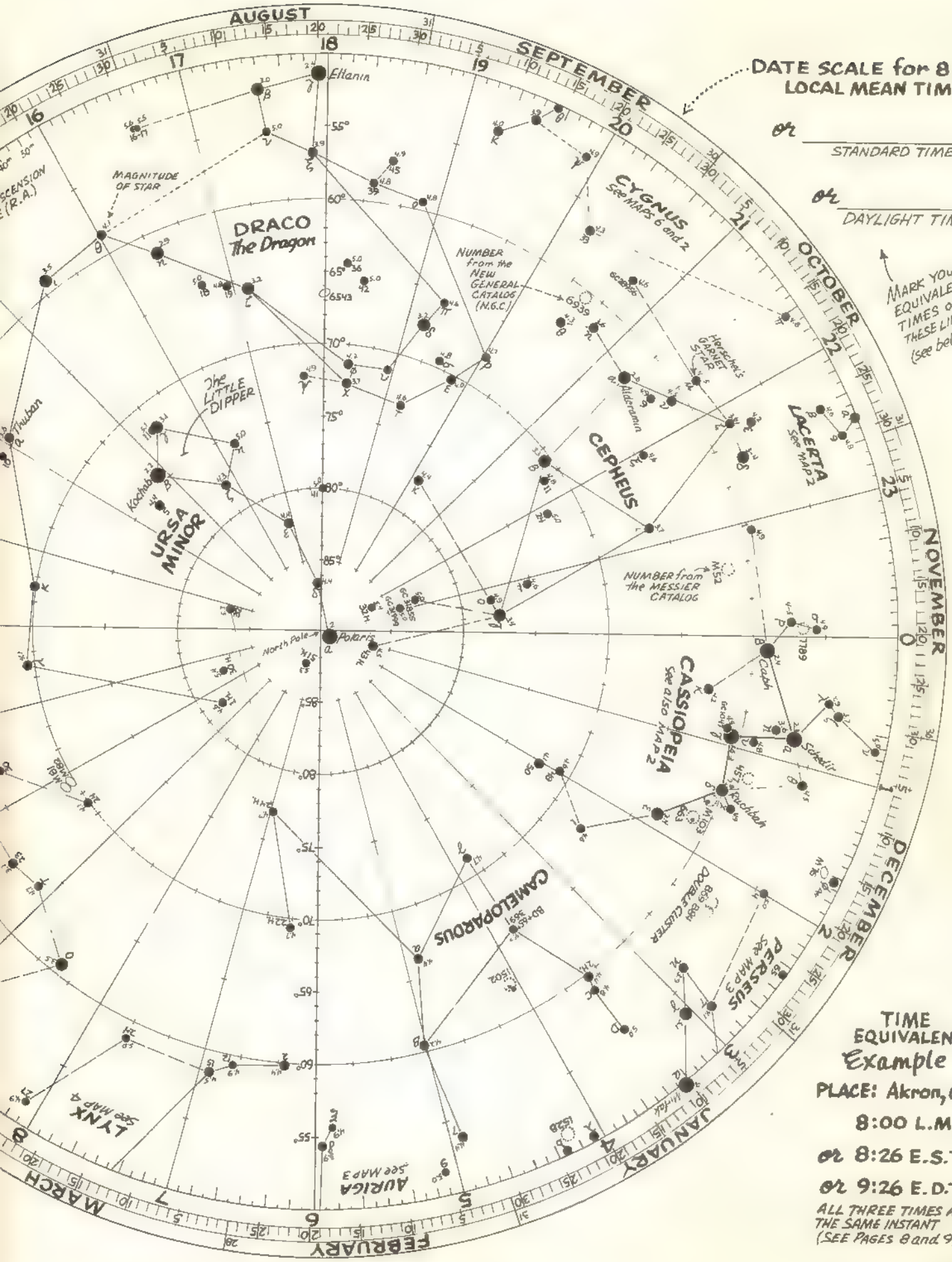
γ	30	32 H.	GC 28956	BD+65°369
GREEK LETTER from the BAYER Catalog	NUMBER from the FLAMSTEED Cat.	NUMBER from the HEVELIUS Catalog	NUMBER from the GENERAL CATALOG (Boss)	NUMBER from the BONN Catalog (Argelander)

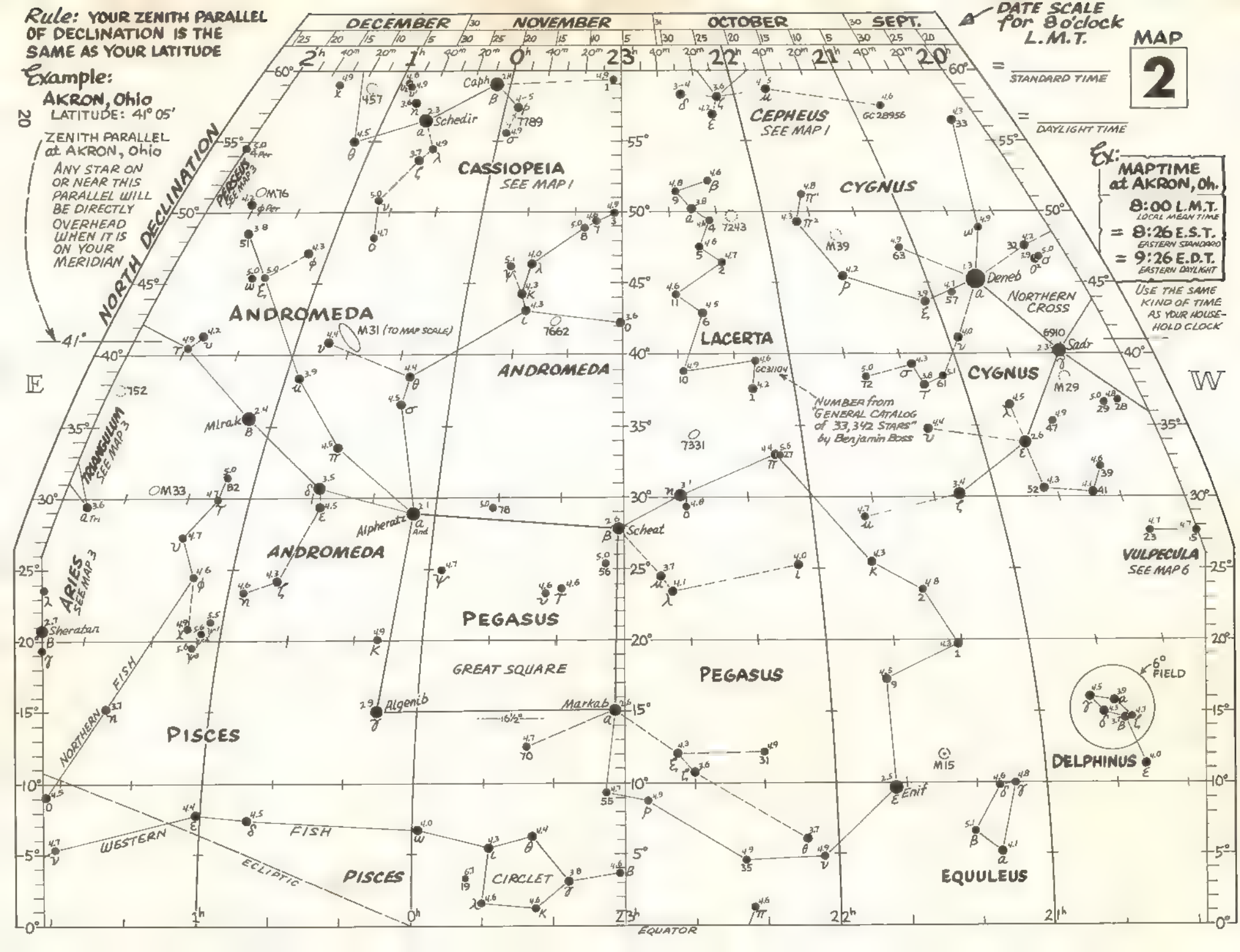
MAP **1** NORTH POLAR

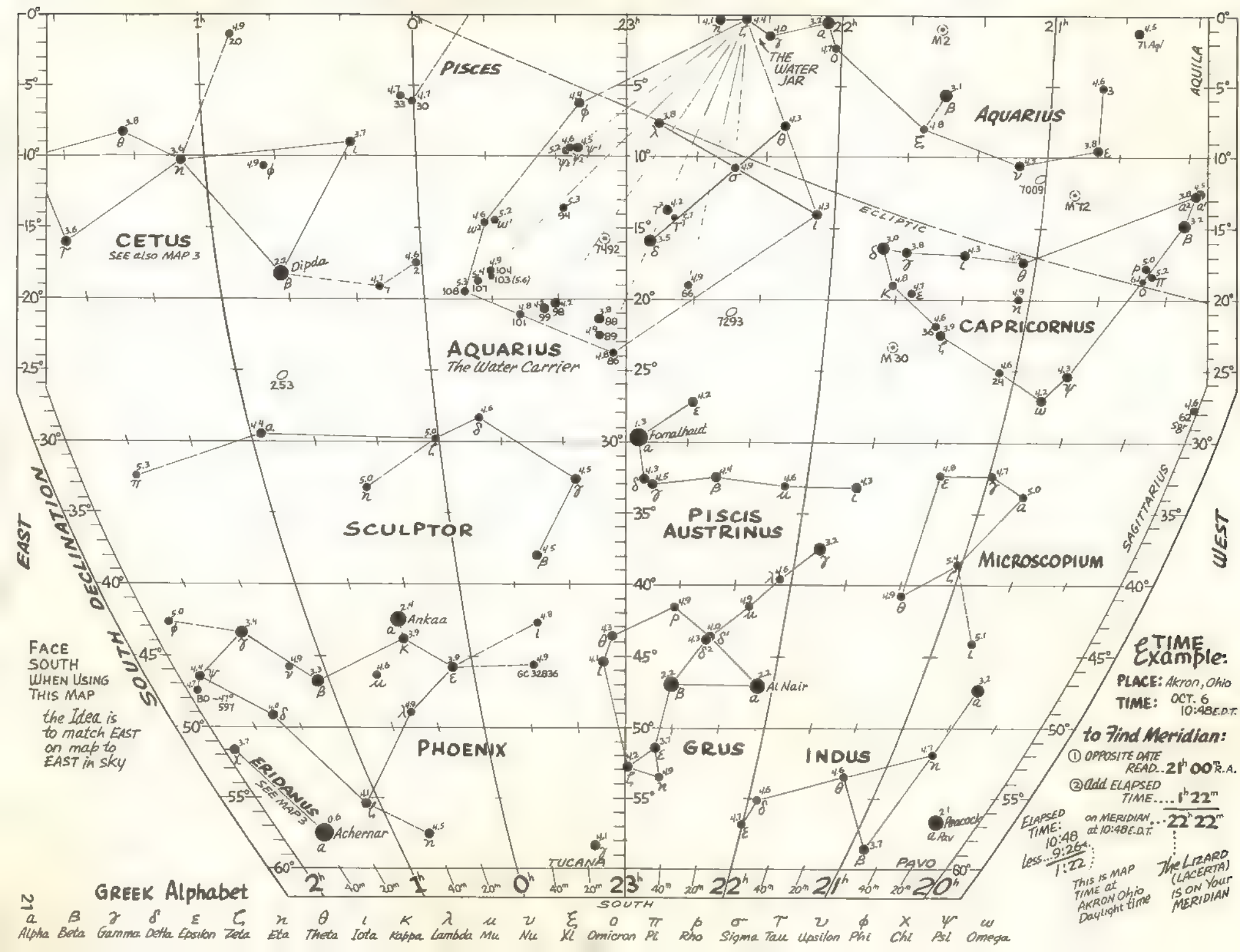


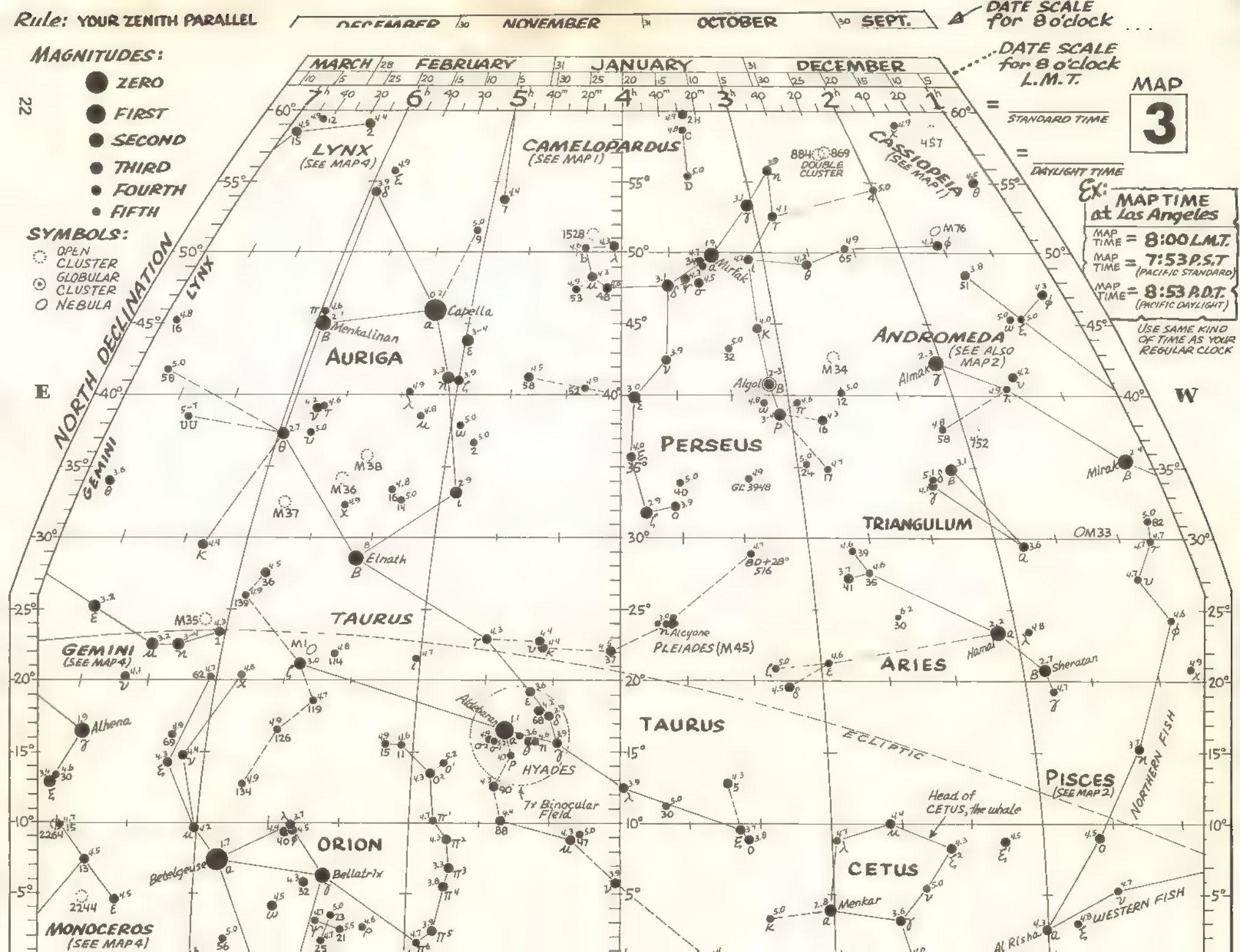
SYMBOLS:

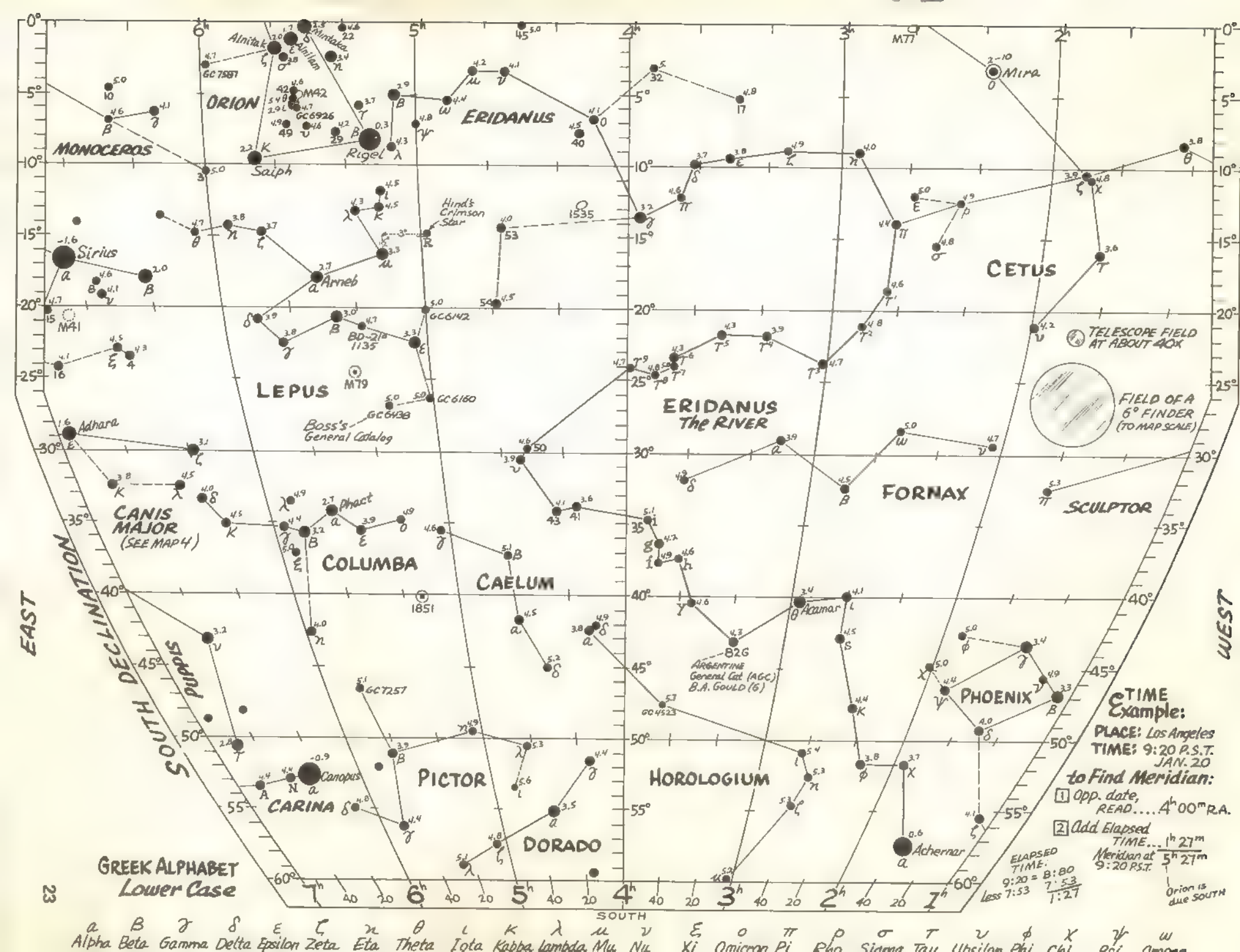
- OPEN CLUSTER
- GLOBULAR CLUSTER
- NEBULA (ANY OBJECT OTHER THAN STAR CLUSTERS)

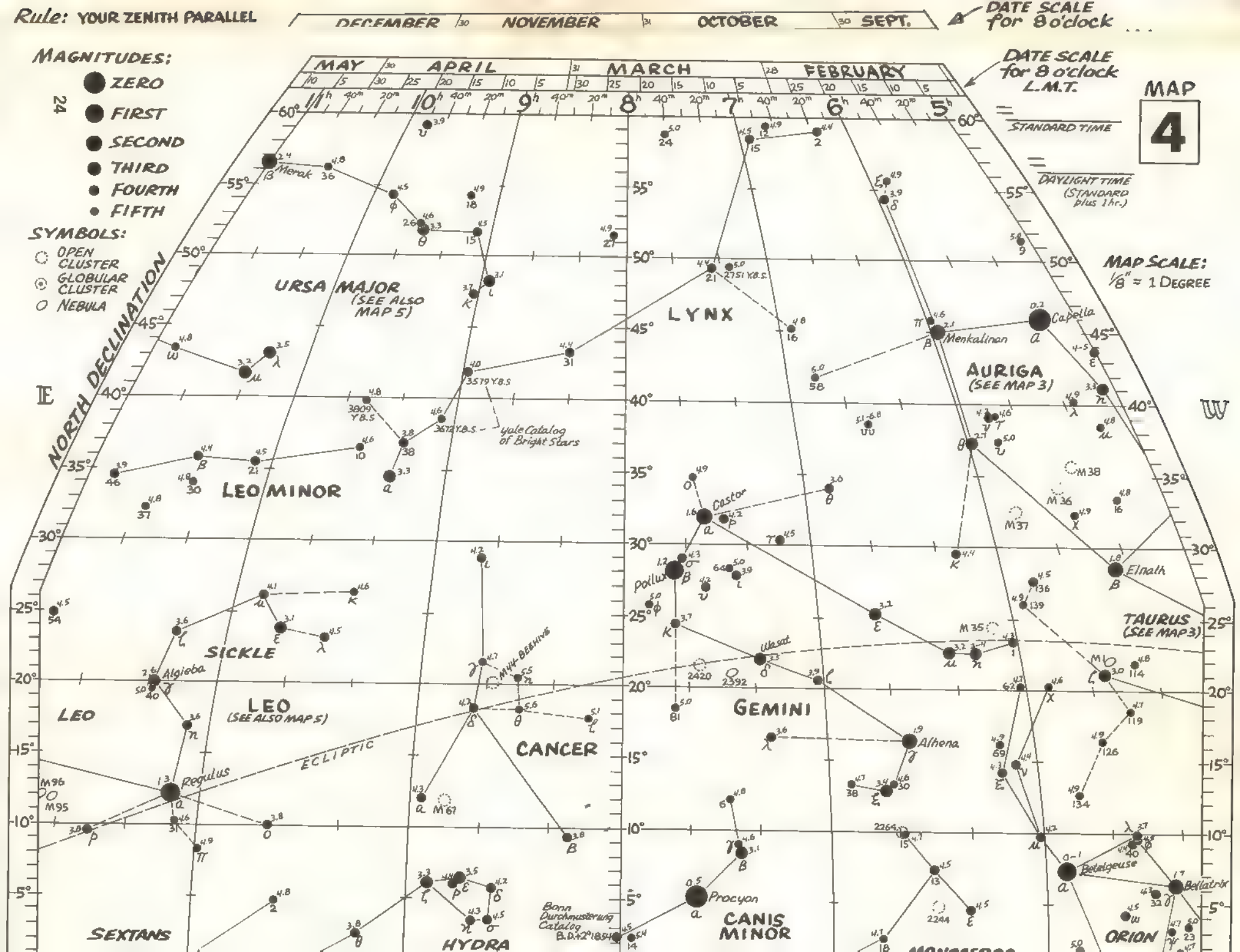

DATE SCALE for 8:00 LOCAL MEAN TIME
or _____ STANDARD TIME
or _____ DAYLIGHT TIME
MARK YOUR EQUIVALENT TIMES on THESE LINES (see below)
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
DRACO The Dragon
CYGNUS See MAPS 6 and 2
CEPHEUS
LACERTA See MAP 2
URSA MINOR
The LITTLE DIPPER
CASSIOPEIA See also MAP 2
CAMELOPARDUS
PERSEUS See MAP 3
AURIGA See MAP 3
LYNX See MAP 4
Eltanin
Thuban
Kochab
Polaris
North Pole
Alderamin
Schedir
Caph
Achird
Navi
Double Cluster
MAGNITUDE OF STAR
NUMBER from the NEW GENERAL CATALOG (N.G.C.)
NUMBER from the MESSIER CATALOG
Herschel's GARNET STAR
RIGHT ASCENSION (R.A.)
TIME EQUIVALENTS
Example
PLACE: Akron, Ohio
8:00 L.M.T.
or 8:26 E.S.T.
or 9:26 E.D.T.
ALL THREE TIMES ARE THE SAME INSTANT
(SEE PAGES 8 and 9)

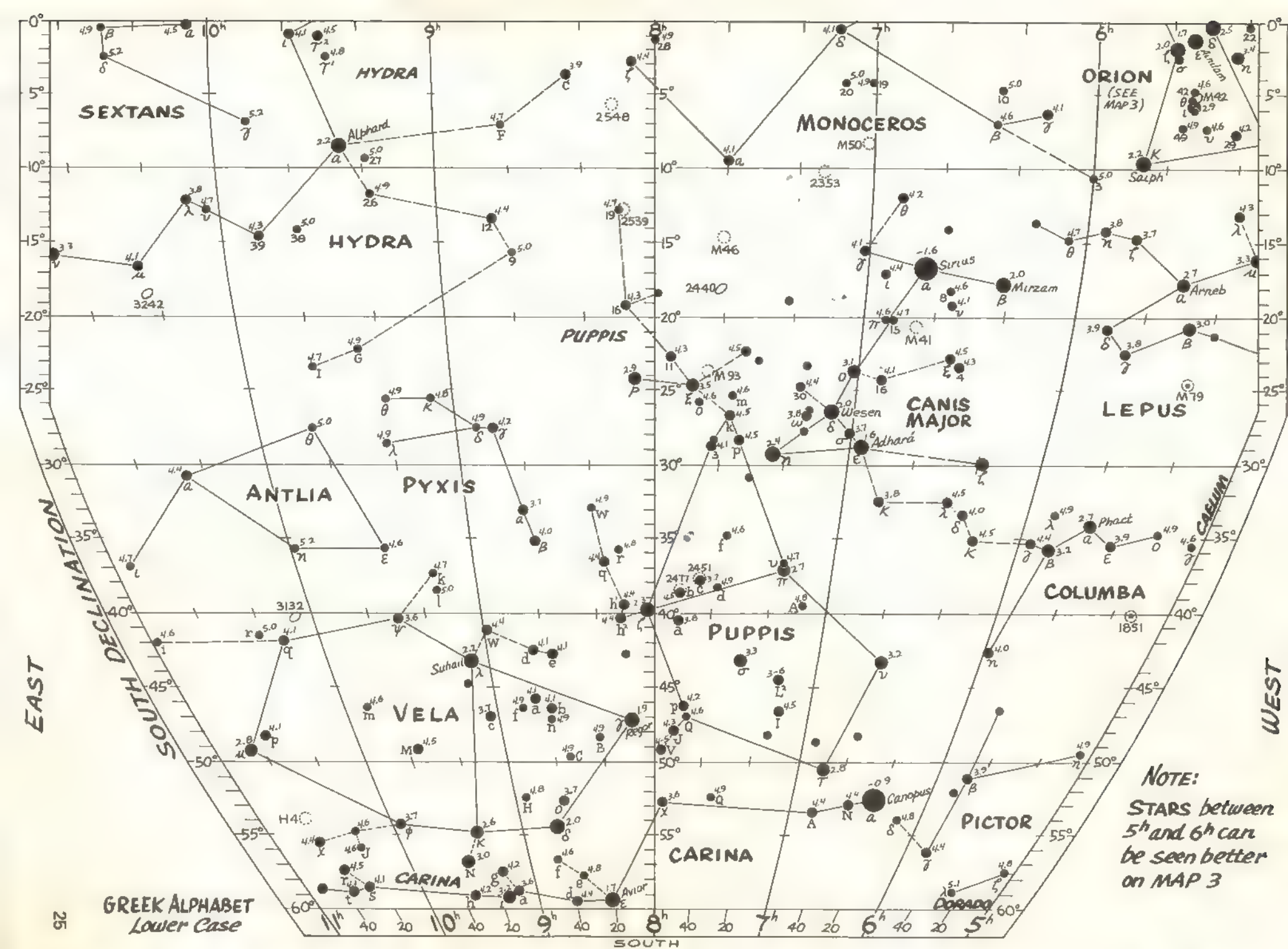

Rule: YOUR ZENITH PARALLEL OF DECLINATION IS THE SAME AS YOUR LATITUDE
Example:
AKRON, Ohio
LATITUDE: 41° 05'
ZENITH PARALLEL at AKRON, Ohio
ANY STAR ON OR NEAR THIS PARALLEL WILL BE DIRECTLY OVERHEAD WHEN IT IS ON YOUR MERIDIAN
NORTH DECLINATION
DECEMBER
NOVEMBER
OCTOBER
SEPT.
DATE SCALE for 8 o'clock L.M.T.
= STANDARD TIME
= DAYLIGHT TIME
MAP 2
Ex:
MAPTIME at AKRON, Oh.
8:00 L.M.T. LOCAL MEAN TIME
= 8:26 E.S.T. EASTERN STANDARD
= 9:26 E.D.T. EASTERN DAYLIGHT
USE THE SAME KIND OF TIME AS YOUR HOUSEHOLD CLOCK
E
W
CASSIOPEIA
SEE MAP 1
CEPHEUS
SEE MAP 1
CYGNUS
ANDROMEDA
M31 (TO MAP SCALE)
LACERTA
NUMBER from "GENERAL CATALOG of 33,342 STARS" by Benjamin Boss
NORTHERN CROSS
Deneb
Sadr
M29
M39
M33
M76
Mirak
Alpheratz
Scheat
Markab
Algenib
Sheratan
Schedir
Caph
TRIANGULUM
SEE MAP 3
ARIES
SEE MAP 3
PERSEUS
SEE MAP 3
PEGASUS
GREAT SQUARE
PISCES
NORTHERN FISH
WESTERN FISH
CIRCLET
ECLIPTIC
EQUATOR
VULPECULA
SEE MAP 6
DELPHINUS
6° FIELD
EQUULEUS
M15
Enif


CETUS
SEE also MAP 3
PISCES
AQUARIUS
The Water Carrier
THE WATER JAR
AQUARIUS
CAPRICORNUS
ECLIPTIC
AQUILA
SCULPTOR
PISCIS AUSTRINUS
MICROSCOPIUM
SAGITTARIUS
PHOENIX
GRUS
INDUS
PAVO
TUCANA
ERIDANUS
SEE MAP 3
Dipda
Fomalhaut
Ankaa
Achernar
Al Nair
Peacock
EAST
WEST
SOUTH
DECLINATION
SOUTH
FACE SOUTH WHEN USING THIS MAP
the Idea is to match EAST on map to EAST in sky
TIME Example:
PLACE: Akron, Ohio
TIME: OCT. 6 10:48 E.D.T.
to Find Meridian:
① OPPOSITE DATE READ.. 21h 00m R.A.
② Add ELAPSED TIME.... 1h 22m
ELAPSED TIME: 10:48 less 9:26
1:22
on MERIDIAN at 10:48 E.D.T. 22h 22m
This is MAP TIME at AKRON Ohio Daylight time
The LIZARD (LACERTA) IS ON Your MERIDIAN
GREEK Alphabet
α Alpha β Beta γ Gamma δ Delta ε Epsilon ζ Zeta η Eta θ Theta ι Iota κ Kappa λ Lambda μ Mu ν Nu ξ Xi ο Omicron π Pi ρ Rho σ Sigma τ Tau υ Upsilon φ Phi χ Chi ψ Psi ω Omega


Rule: YOUR ZENITH PARALLEL
DECEMBER 30 NOVEMBER 31 OCTOBER 30 SEPT.
DATE SCALE for 8 o'clock
MAGNITUDES:
ZERO
FIRST
SECOND
THIRD
FOURTH
FIFTH
SYMBOLS:
OPEN CLUSTER
GLOBULAR CLUSTER
NEBULA
MARCH 28 FEBRUARY 31 JANUARY 31 DECEMBER
DATE SCALE for 8 o'clock L.M.T.
= STANDARD TIME
= DAYLIGHT TIME
MAP 3
Ex: MAP TIME at Los Angeles
MAP TIME = 8:00 L.M.T.
MAP TIME = 7:53 P.S.T. (PACIFIC STANDARD)
MAP TIME = 8:53 P.D.T. (PACIFIC DAYLIGHT)
USE SAME KIND OF TIME AS YOUR REGULAR CLOCK
NORTH DECLINATION
E
W
LYNX
(SEE MAP 4)
CAMELOPARDUS
(SEE MAP 1)
CASSIOPEIA
(SEE MAP 1)
884 869 DOUBLE CLUSTER
M76
LYNX
Capella
Menkalinan
AURIGA
Mirfak
ANDROMEDA
(SEE ALSO MAP 2)
Almak
Algol
M34
GEMINI
M38
M36
M37
PERSEUS
GC 3948
Mirak
TRIANGULUM
M33
Elnath
TAURUS
BD+28° 516
Alcyone
PLEIADES (M45)
ARIES
Hamal
Sheratan
GEMINI
(SEE MAP 4)
M1
Aldebaran
HYADES
7x Binocular Field
ECLIPTIC
Head of CETUS, the whale
PISCES
(SEE MAP 2)
NORTHERN FISH
Betelgeuse
Bellatrix
ORION
CETUS
Menkar
Al Risha
WESTERN FISH
MONOCEROS
(SEE MAP 4)

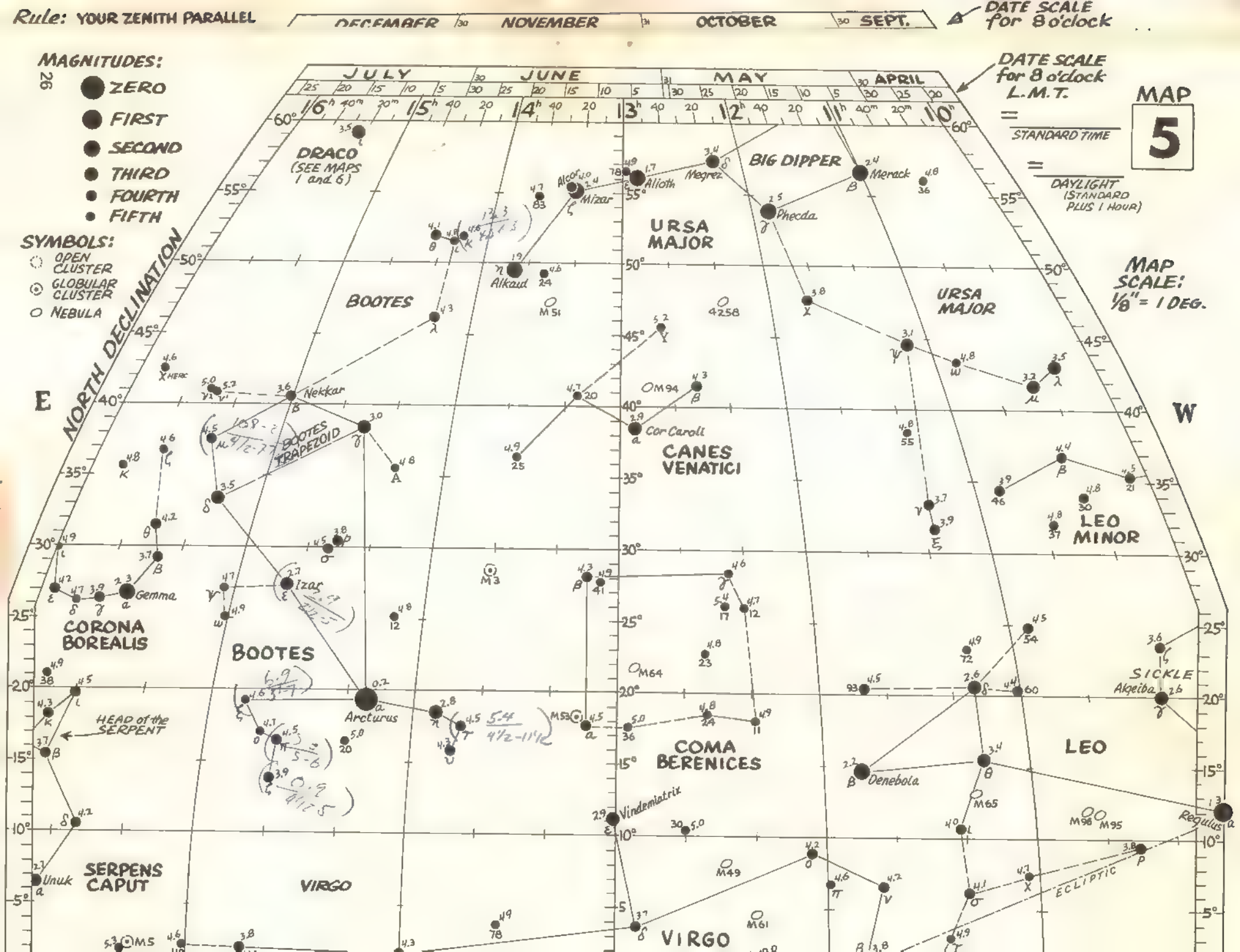

ORION
MONOCEROS
ERIDANUS
LEPUS
CANIS MAJOR
(SEE MAP 4)
COLUMBA
CAELUM
PICTOR
CARINA
DORADO
HOROLOGIUM
FORNAX
SCULPTOR
PHOENIX
CETUS
ERIDANUS
The RIVER
Sirius
Canopus
Rigel
Betelgeuse
Alnitak
Alnilam
Mintaka
Saiph
Arneb
Adhara
Phact
Achernar
Acamar
Mira
M41
M42
M79
M77
1851
1535
GC 7987
GC6926
GC6142
GC6160
GC6438
GC7257
GC4523
BD-2° 1135
Hind's Crimson Star
Boss's General Catalog
ARGENTINE General Cat (AGC) B.A. GOULD (6)
82G
TELESCOPE FIELD AT ABOUT 40x
FIELD OF A 6° FINDER (TO MAP SCALE)
EAST
WEST
SOUTH
SOUTH DECLINATION DEGREES
TIME Example:
PLACE: Los Angeles
TIME: 9:20 P.S.T. JAN. 20
to Find Meridian:
1 Opp. date, READ.... 4h 00m R.A.
2 Add Elapsed TIME... 1h 27m
Meridian at 9:20 P.S.T. 5h 27m
Orion is due SOUTH
ELAPSED TIME: 9:20 = 8:80 Less 7:53 1:27
GREEK ALPHABET Lower Case
a Alpha B Beta γ Gamma δ Delta ε Epsilon ζ Zeta η Eta θ Theta ι Iota κ Kappa λ Lambda μ Mu ν Nu ξ Xi ο Omicron π Pi ρ Rho σ Sigma τ Tau υ Upsilon φ Phi χ Chi ψ Psi ω Omega

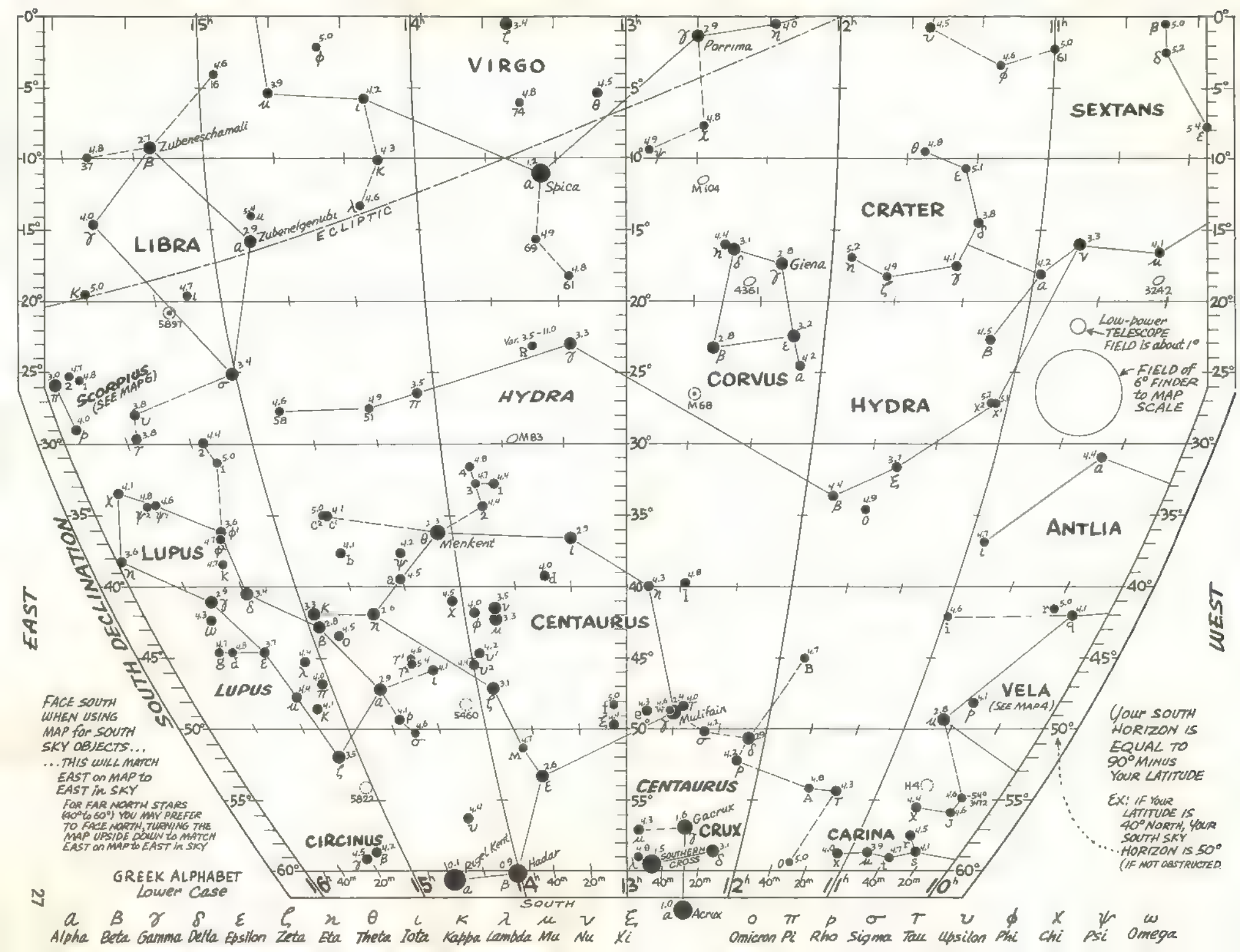

Rule: YOUR ZENITH PARALLEL
DECEMBER 30 NOVEMBER 31 OCTOBER 30 SEPT.
DATE SCALE for 8 o'clock ...
MAGNITUDES:
ZERO
FIRST
SECOND
THIRD
FOURTH
FIFTH
SYMBOLS:
OPEN CLUSTER
GLOBULAR CLUSTER
NEBULA
MAY 30 APRIL 31 MARCH 28 FEBRUARY
DATE SCALE for 8 o'clock L.M.T.
STANDARD TIME
DAYLIGHT TIME (STANDARD plus 1 hr.)
MAP 4
MAP SCALE: 1/8" = 1 DEGREE
NORTH DECLINATION
E
W
URSA MAJOR (SEE ALSO MAP 5)
LYNX
AURIGA (SEE MAP 3)
LEO MINOR
SICKLE
LEO (SEE ALSO MAP 5)
CANCER
GEMINI
TAURUS (SEE MAP 3)
SEXTANS
HYDRA
CANIS MINOR
ORION
ECLIPTIC
Merak
Menkalinan
Capella
Castor
Pollux
Algieba
Regulus
Alhena
Elnath
Procyon
Betelgeuse
Bellatrix
Yale Catalog of Bright Stars
Bonn Durchmusterung Catalog B.D.+2°1854
M44 BEEHIVE
M67
M95
M96
M35
M36
M37
M38

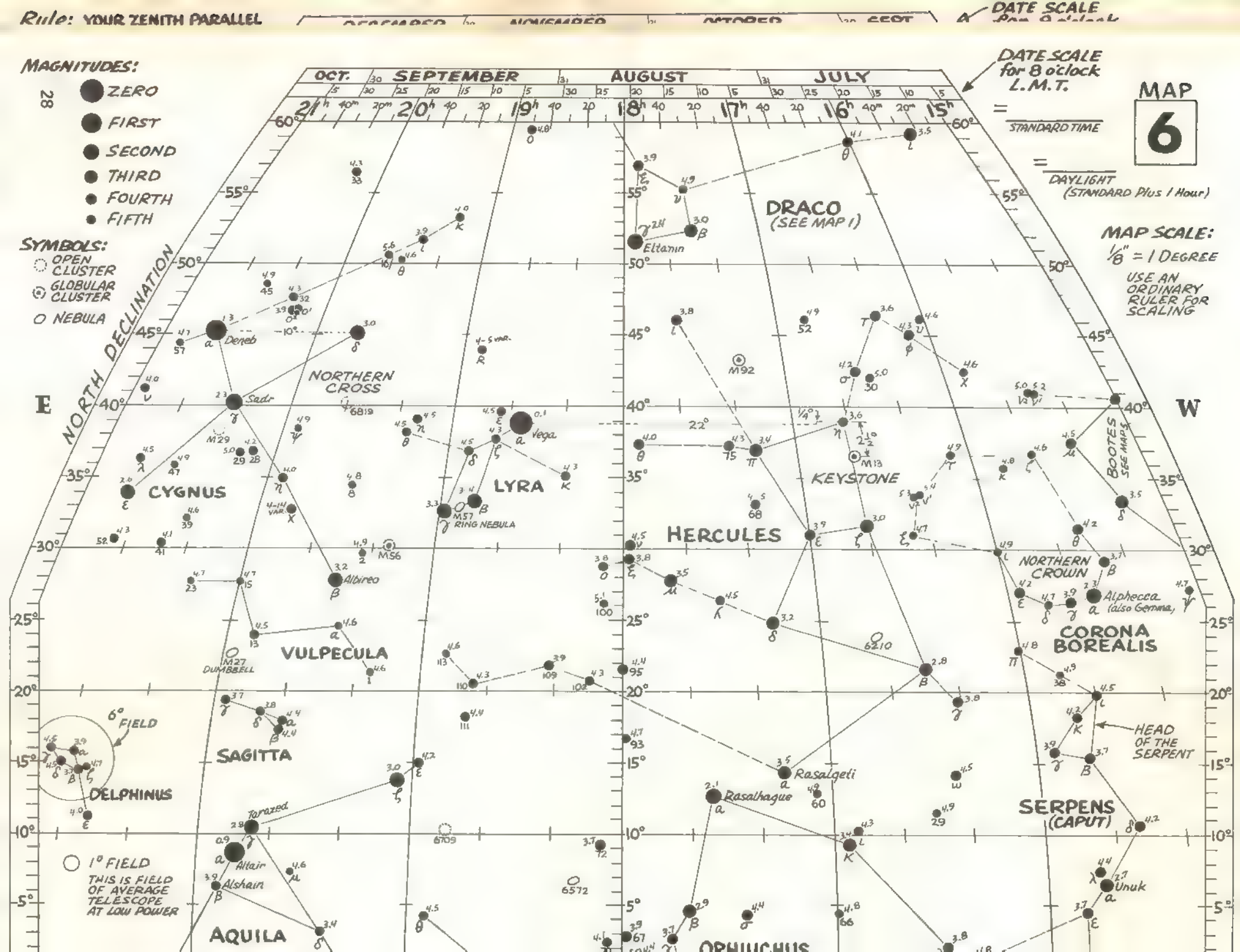


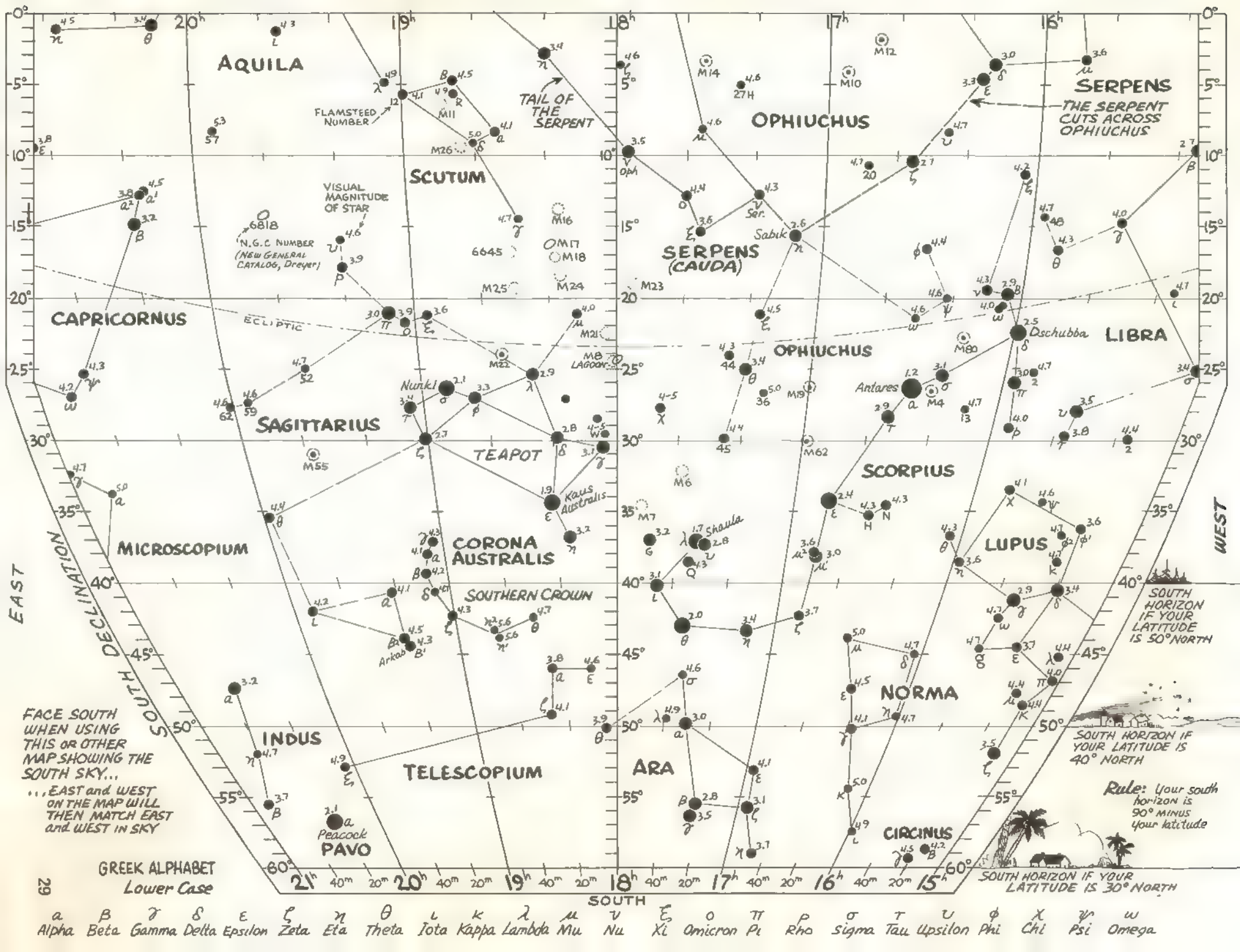
GREEK ALPHABET
Lower Case

a	β	γ	δ	ε	ζ	η	θ	ι	κ	λ	μ	ν	ξ	ο	π	ρ	σ	τ	υ	φ	χ	ψ	ω
Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Iota	Kappa	Lambda	Mu	Nu	Xi	Omicron	Pi	Rho	Sigma	Tau	Upsilon	Phi	Chi	Psi	Omega


Rule: YOUR ZENITH PARALLEL
DECEMBER
NOVEMBER
OCTOBER
SEPT.
DATE SCALE for 8 o'clock
MAGNITUDES:
ZERO
FIRST
SECOND
THIRD
FOURTH
FIFTH
SYMBOLS:
OPEN CLUSTER
GLOBULAR CLUSTER
NEBULA
NORTH DECLINATION
JULY
JUNE
MAY
APRIL
DATE SCALE for 8 o'clock L.M.T.
= STANDARD TIME
= DAYLIGHT (STANDARD PLUS 1 HOUR)
MAP 5
MAP SCALE: 1/8" = 1 DEG.
E
W
DRACO (SEE MAPS 1 and 6)
BOOTES
BOOTES TRAPEZOID
CORONA BOREALIS
SERPENS CAPUT
HEAD of the SERPENT
VIRGO
URSA MAJOR
BIG DIPPER
CANES VENATICI
COMA BERENICES
LEO MINOR
LEO
SICKLE
ECLIPTIC
Alkaid
Mizar
Alcor
Alioth
Megrez
Phecda
Merack
Nekkar
Izar
Gemma
Arcturus
Unuk
Cor Caroli
Denebola
Vindemiatrix
Algeiba
Regulus
M51
M94
M3
M64
M53
M5
M49
M61
M65
M98
M95
4258

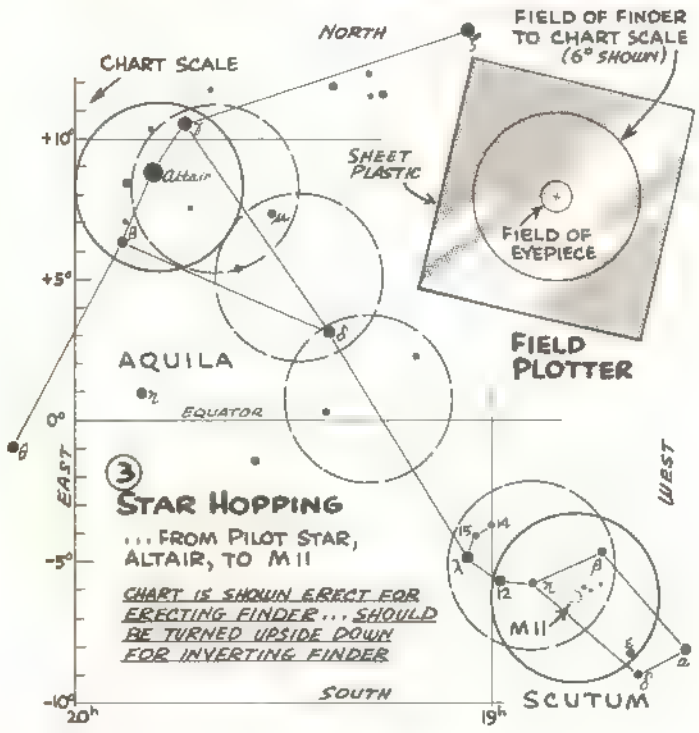

VIRGO
LIBRA
SCORPIUS (SEE MAP6)
LUPUS
CENTAURUS
CIRCINUS
HYDRA
CORVUS
CRATER
SEXTANS
ANTLIA
VELA (SEE MAP4)
CARINA
CRUX
Spica
Zubeneschamali
Zubenelgenubi
ECLIPTIC
Porrima
Giena
Menkent
Rigil Kent
Hadar
Acrux
Gacrux
Mulifain
SOUTHERN CROSS
M104
M83
M68
5897
5460
5822
4361
3242
EAST
WEST
SOUTH
SOUTH DECLINATION
FACE SOUTH WHEN USING MAP for SOUTH SKY OBJECTS...
...THIS WILL MATCH EAST on MAP to EAST in SKY
FOR FAR NORTH STARS (40° to 60°) YOU MAY PREFER TO FACE NORTH, TURNING THE MAP UPSIDE DOWN to MATCH EAST on MAP to EAST in SKY
Low-power TELESCOPE FIELD is about 1°
FIELD of 6° FINDER to MAP SCALE
Your SOUTH HORIZON IS EQUAL TO 90° MINUS YOUR LATITUDE
EX: IF YOUR LATITUDE IS 40° NORTH, YOUR SOUTH SKY HORIZON IS 50° (IF NOT OBSTRUCTED)
GREEK ALPHABET Lower Case
α Alpha β Beta γ Gamma δ Delta ε Epsilon ζ Zeta η Eta θ Theta ι Iota κ Kappa λ Lambda μ Mu ν Nu ξ Xi
ο Omicron π Pi ρ Rho σ Sigma τ Tau υ Upsilon φ Phi χ Chi ψ Psi ω Omega


Rule: YOUR ZENITH PARALLEL
DATE SCALE for 8 o'clock L.M.T.
= STANDARD TIME
= DAYLIGHT (STANDARD Plus 1 Hour)
MAP 6
MAGNITUDES:
ZERO
FIRST
SECOND
THIRD
FOURTH
FIFTH
SYMBOLS:
OPEN CLUSTER
GLOBULAR CLUSTER
NEBULA
MAP SCALE:
1/8" = 1 DEGREE
USE AN ORDINARY RULER FOR SCALING
OCT. SEPTEMBER AUGUST JULY
NORTH DECLINATION
E
W
DRACO (SEE MAP 1)
Eltanin
Deneb
Sadr
NORTHERN CROSS
CYGNUS
Vega
LYRA
M57 RING NEBULA
Albireo
M29
M27 DUMBBELL
VULPECULA
M92
KEYSTONE
M13
HERCULES
BOOTES (SEE MAPS)
NORTHERN CROWN
Alphecca (also Gemma)
CORONA BOREALIS
HEAD OF THE SERPENT
SERPENS (CAPUT)
Rasalgeti
Rasalhague
OPHIUCHUS
SAGITTA
Tarazed
Altair
Alshain
AQUILA
DELPHINUS
6° FIELD
1° FIELD
THIS IS FIELD OF AVERAGE TELESCOPE AT LOW POWER
Unuk

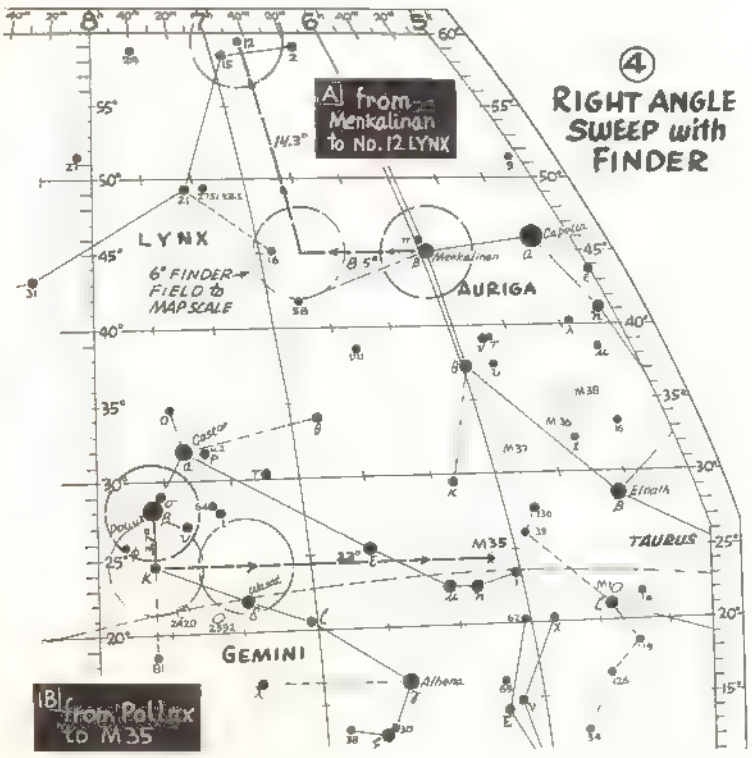

AQUILA
SCUTUM
FLAMSTEED NUMBER
TAIL OF THE SERPENT
VISUAL MAGNITUDE OF STAR
N.G.C NUMBER (NEW GENERAL CATALOG, Dreyer)
M11
M16
M17
M18
M24
M25
6645
6818
OPHIUCHUS
SERPENS
THE SERPENT CUTS ACROSS OPHIUCHUS
SERPENS (CAUDA)
Sabik
M12
M14
M10
27H
CAPRICORNUS
ECLIPTIC
M22
M21
M8 LAGOON
SAGITTARIUS
TEAPOT
M55
Nunki
Kaus Australis
LIBRA
Dschubba
Antares
M4
M80
M19
M62
SCORPIUS
M6
M7
Shaula
LUPUS
MICROSCOPIUM
CORONA AUSTRALIS
SOUTHERN CROWN
Arkab
NORMA
INDUS
TELESCOPIUM
ARA
Peacock
PAVO
CIRCINUS
M23
EAST
WEST
SOUTH
DECLINATION
SOUTH HORIZON IF YOUR LATITUDE IS 50° NORTH
SOUTH HORIZON IF YOUR LATITUDE IS 40° NORTH
SOUTH HORIZON IF YOUR LATITUDE IS 30° NORTH
Rule: Your south horizon is 90° minus your latitude
FACE SOUTH WHEN USING THIS OR OTHER MAP SHOWING THE SOUTH SKY...
...EAST and WEST ON THE MAP WILL THEN MATCH EAST and WEST IN SKY
GREEK ALPHABET
Lower Case
α Alpha β Beta γ Gamma δ Delta ε Epsilon ζ Zeta η Eta θ Theta ι Iota κ Kappa λ Lambda μ Mu ν Nu ξ Xi ο Omicron π Pi ρ Rho σ Sigma τ Tau υ Upsilon φ Phi χ Chi ψ Psi ω Omega

Finding Methods

① M11 - OPEN CLUSTER
MANY TINY STARS GIVE A GLOWING EFFECT. EASY TO SEE WITH 3 TO 6" AT 40X



③ STAR HOPPING
... FROM PILOT STAR, ALTAIR, TO M11
CHART IS SHOWN ERECT FOR ERECTING FINDER ... SHOULD BE TURNED UPSIDE DOWN FOR INVERTING FINDER



④ RIGHT ANGLE SWEEP with FINDER

VARIOUS methods are used in locating sky objects with a telescope, ranging from coarse naked-eye sighting to precise pin-pointing with the use of setting circles. All methods require a good mount--it must not vibrate unduly, it must "stay put" at any position and it must work smoothly on both axes. Don't expect to find sky objects by random sweeping--you must know exactly what you are looking for and how to get there.

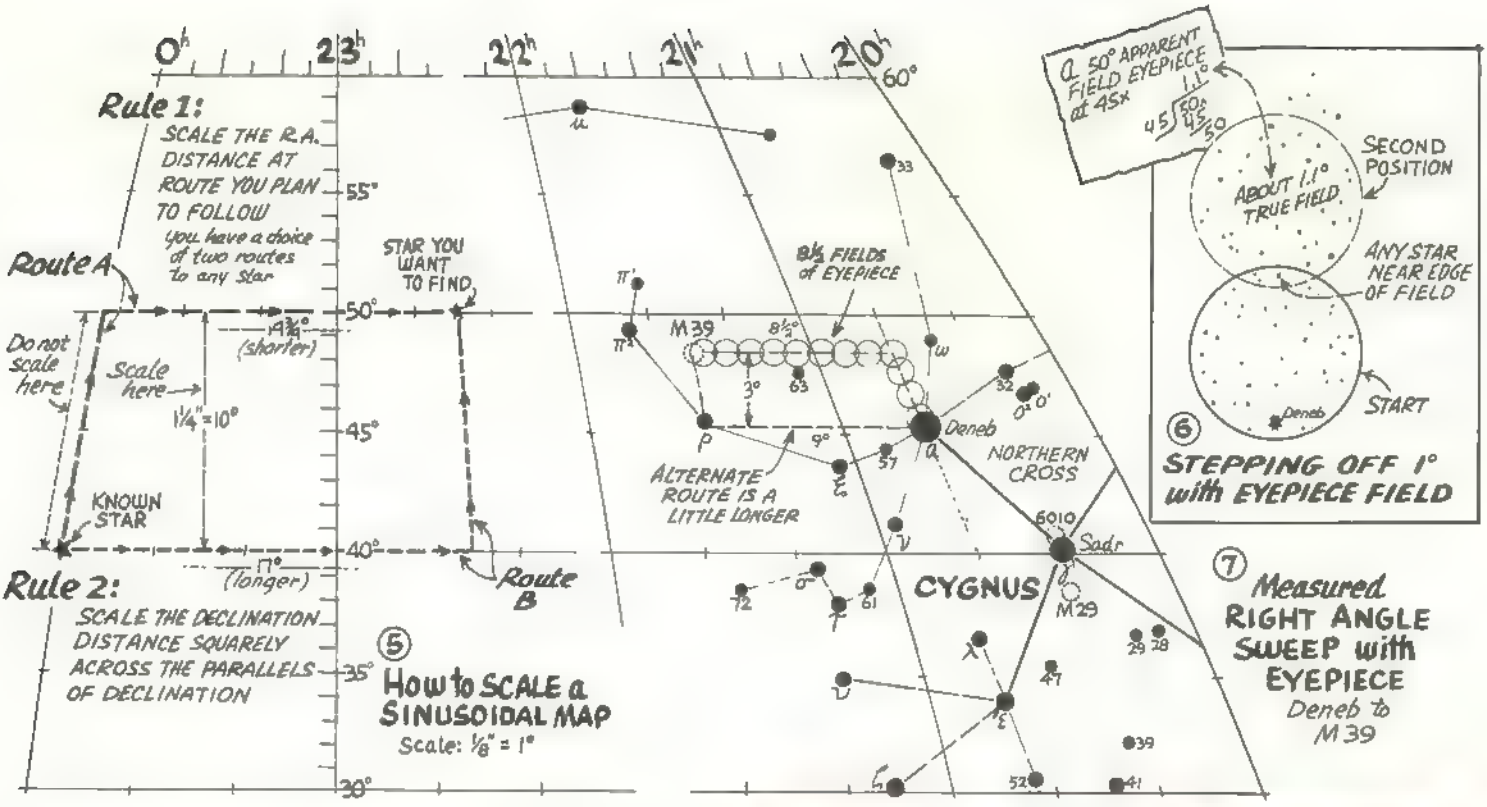
STAR HOPPING. This is the familiar technique of moving from a bright star you know to another star you know, etc., and in this way you eventually reach your target. It is an excellent method for sweeping with binoculars or erect-image telescopes. With the usual astronomical telescope, star hopping is done with the finder telescope of the instrument. A needed accessory is a "field plotter," which is piece of clear sheet plastic on which you draw the field of the finder to map scale. The maps in this book have a scale of 1/8 inch per degree, so if you have the usual 6-deg. finder the field plotter will have a circle 3/4 in. diameter. The same scale measures both declination and R.A. with fair accuracy.

First you plot the course on the atlas map, moving the plastic circle over the map, trying to keep a known star in the circle while reaching out to another star. After you have the route memorized, you repeat the same star hops with the telescope itself. A common example is the hop from Altair to M 11, as shown in Fig. 3.

RIGHT ANGLE SWEEP. This is by far the most practical method for use with an equatorial mount. This kind of mount can be made to move in a diagonal direction if you push firmly in that direction, but the normal movements of an equatorial are in R.A. and declination, these being at right angles in all parts of the sky. Two examples of a right angle sweep are shown in Fig. 4, both using the finder for the actual sighting. Both legs of the sweep can be scaled with a field plotter; the finder field then enables you to make similar steps in the sky.

You will note that in this kind of sweep you have a choice of two routes. In Fig. 7 example there is a convenient pivot star on the lower route, so you may prefer to take that path.

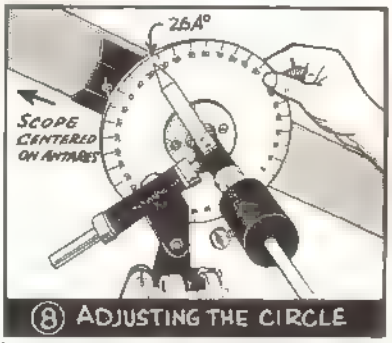
Fig. 5 gives the two rules you have to follow in plotting a right angle sweep on a sinusoidal star map. Since you have a choice of two routes,



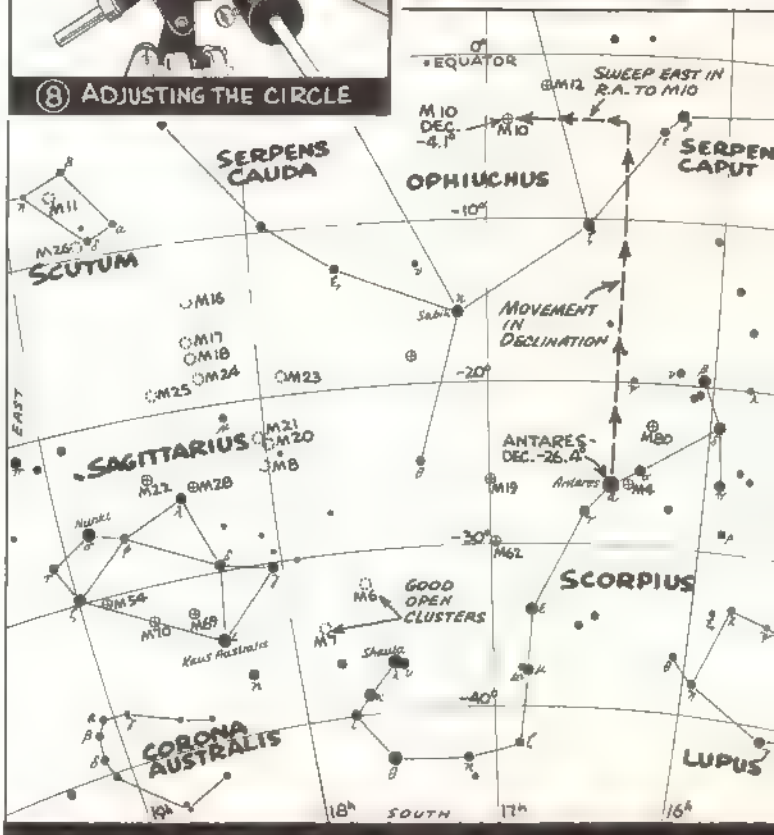
you should measure the angular distance in R.A. along the route you plan to use. The second rule is that a difference in declination should be referred to the central meridian; another way of saying this is simply that the declination difference should be measured squarely across the parallels of declination, NOT on the actual map path which is usually somewhat slanted and so would scale a little longer.

DECLINATION CIRCLE. A declination circle is easy to use and does not require a clock drive; many amateur observers use the declination circle alone to find sky objects. Fig. 9 is a typical example, being a right angle sweep from Antares to the globular cluster M 10. You use the declination circle to set the declination distance and then sweep in R.A. to the object. The preliminary operation is to point your telescope exactly at your pilot star, Antares, and then set the declination circle to the known declination of Antares (see the star list on a following page). Without looking at the sky, you now move the telescope to the declination of M 10. You lock the declination shaft at this position. Finally, you sweep in R.A. to the east until the object comes into view. If you miss the target, try R.A. sweeps about 3/4-deg. north and south of the indicated path.

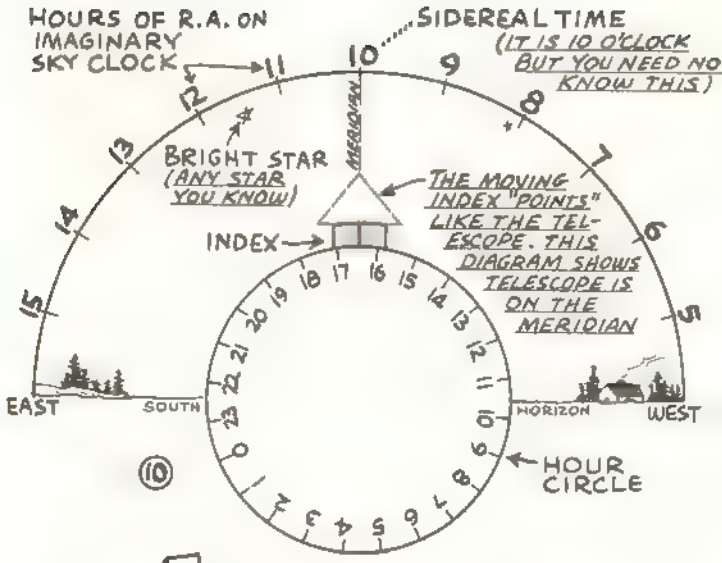
THE HOUR CIRCLE. Hour circles are made in various patterns, the chief difference being the hour sequence which can be either clockwise or counterclockwise. If you use a clockwise circle



⑧ ADJUSTING THE CIRCLE

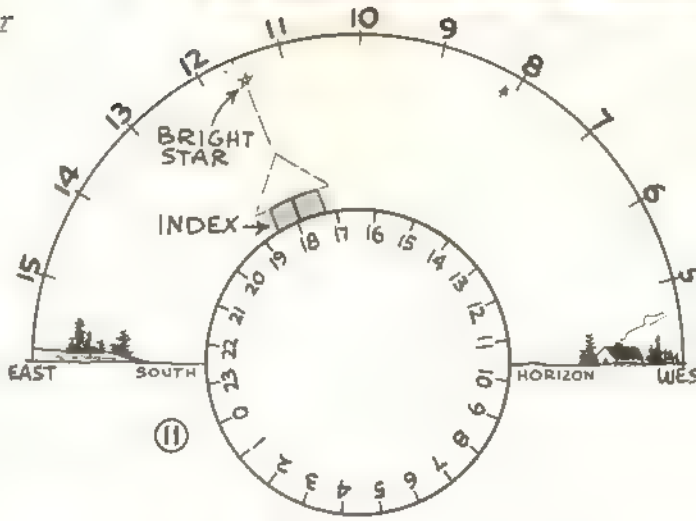


⑨ USING DECLINATION CIRCLE: CIRCLE SETS THE DECLINATION and YOU SWEEP in R.A. to OBJECT



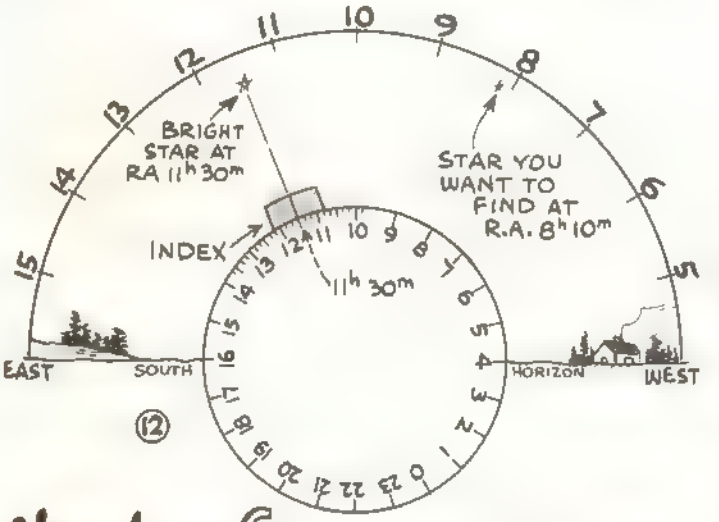
at Start

THE HOUR CIRCLE IS IN ANY CHANCE POSITION. THE MOVING INDEX POINTS IN SAME DIRECTION AS TELESCOPE. *THE INDEX SETTING IS A PERMANENT ADJUSTMENT*



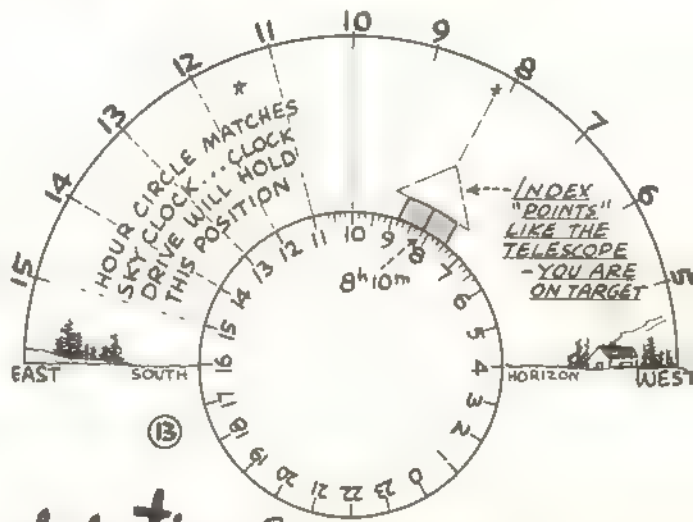
Operation 1

POINT THE TELESCOPE AT ANY BRIGHT STAR WHOSE R.A. IS KNOWN TO YOU. CENTER THE STAR IN FIELD OF EYEPIECE. R.A. OF STAR SHOWN IS $11^h\ 30^m$



Operation 2

SLIP-TURN THE HOUR CIRCLE TO PUT R.A. OF PILOT STAR ($11^h 30^m$) IN LINE WITH THE INDEX. *NOTE THE HOUR CIRCLE NOW MATCHES THE SKY CLOCK*



Operation 3

INDEX DIRECTLY TO THE STAR YOU WANT TO FIND ($8^h\ 10^m$ IN DRAWING). IF ON CLOCK DRIVE, YOU CAN CONTINUE DIRECT INDEXING TO OTHER SKY OBJECTS AS LONG AS YOU LIKE

with a fixed index, the circle will read only Hour Angle, i.e., you can read the position of any sky object as being a certain number of hours and minutes east or west from your meridian. To apply this system you must know the R.A. of the object and the R.A. hour and minute on your meridian. Then, subtracting the smaller quantity from the larger, you get the hour angle of the sky object, which is west if the R.A. of your meridian is greater, or east if the R.A. of the object is greater. This system has been in use for hundreds of years but it is confusing and cumbersome.

DIRECT INDEXING. If you use an hour circle with a 24-hr. counterclockwise sequence of hour numbers, you can use the circle with a moving index for direct indexing. By a "moving index" is meant an index which moves when the telescope is moved--you can treat it as a fixed part of the polar shaft assembly. Initially it is set to point to the meridian when the declination shaft is in a horizontal position. The method of operation is shown in the drawings. If you are on clock drive, the clock will keep the circle in proper relation to the stars. Without a clock, you can index as usual and then add the elapsed time.

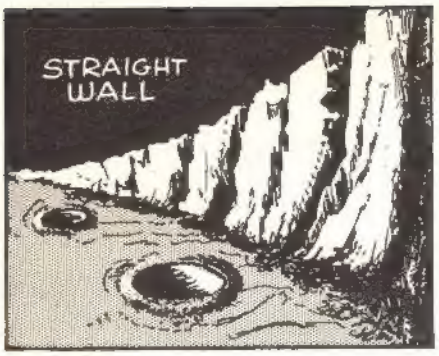
Star Positions 1970

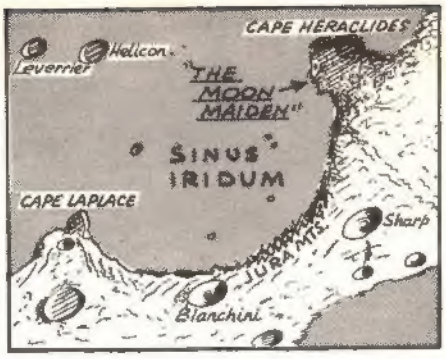
ALL STARS of MAGNITUDE 2.8 or Brighter to 60° SOUTH DECLINATION

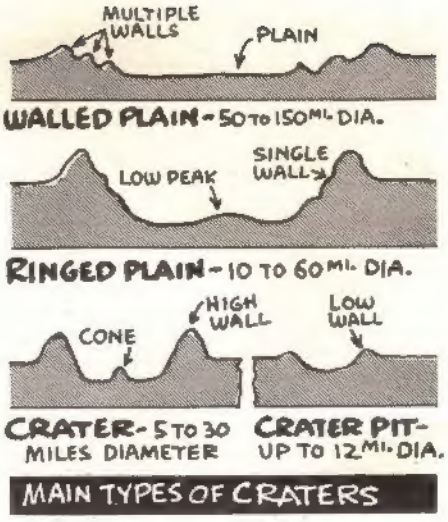
STAR NAME		MAG.	POSITION	
BAYER	POPULAR		R.A.	DEC.
α And	ALPHERATZ	2.1	0h07m	+28.9°
β Cas	CAPH	2.4	0 08	+59.0°
α Phe	ANKAA	2.4	0 25	-42.5°
α Cas	SCHEDAR	2.3	0 39	+56.4°
β Cet	DIPDA	2.2	0 42	-18.2°
γ Cas	Gamma CASS	2.3 VAR.	0 55	+60.6°
β And	MIRACH	2.4	1h08m	+35.5°
δ Cas	RUCKBAH	2.8	1 24	+60.1°
α Eri	ACHERNAR	0.6	1 37	-57.4°
β Ari	SHERATON	2.7	1 53	+20.7°
γ And	ALMAK	2.2	2h02m	+42.2°
α UMi	POLARIS	2.1	2 03	+89.1°
α Ari	HAMAL	2.2	2 05	+23.3°
α Cet	MENKAR	2.8	3h01m	+4.0°
β Per	ALGOL	2.8 VAR.	3 06	+40.8°
α Per	MIRFAK	1.9	3 22	+49.8°
α Tau	ALDEBARAN	1.1	4h34m	+16.4°
β Ori	RIGEL	0.3	5h13m	-8.2°
α Aur	CAPELLA	0.2	5 14	+46.0°
γ Ori	BELLATRIX	1.7	5 24	+6.3°
β Tau	ELNATH	1.8	5 24	+28.6°
δ Ori	MINTAKA	2.5	5 30	-0.3°
α Lep	ARNEB	2.7	5 31	-17.9°
ε Ori	ALNILAM	1.7	5 35	-1.2°
α Col	PHACT	2.7	5 39	-34.1°
ζ Ori	ALNITAK	2.0	5 39	-2.0°
κ Ori	Kappa ORION	2.2	5 46	-9.7°
α Ori	BETELGEUSE	0-1 VAR.	5 54	+7.4°
β Aur	MENKALINAN	2.1	5 57	+45.0°
θ Aur	Theta AURIGA	2.7	5 58	+37.2°
β CMa	MIRZAM	2.0	6h21m	-17.9°
α Car	CANOPUS	-0.9	6 23	-52.7°
γ Gem	ALHENA	1.9	6 36	+16.4°
α CMa	SIRIUS	-1.6	6 44	-16.7°
τ Pup	Tau PUPPIS	2.8	6 49	-50.6°
ε CMa	ADARA	1.6	6 57	-28.9°
δ CMa	WEZEN	2.0	7h07m	-26.4°

STAR NAME		MAG.	POSITION	
BAYER	POPULAR		R.A.	DEC.
π Pup	Pi PUPPIS	2.7	7h16m	-37.1°
η CMa	Eta CANIS MAJOR	2.4	7 23	-29.3°
α Gem	CASTOR	1.6	7 33	+32.0°
α CMi	PROCYON	0.5	7 38	+5.3°
β Gem	POLLUX	1.2	7 43	+28.1°
ζ Pup	Zeta PUPPIS	2.3	8h03m	-39.9°
γ Vel	Gamma VELA	1.9	8 09	-47.3°
ε Car	AVIOR	1.7	8 22	-59.4°
δ Vel	Delta VELA	2.0	8 44	-54.6°
λ Vel	SUHAIL	2.2	9h07m	-43.3°
ι Car	Iota CARINA	2.2	9 16	-59.2°
κ Vel	Kappa VELA	2.6	9 21	-54.9°
α Hya	ALPHARD	2.2	9 26	-8.5°
α Leo	REGULUS	1.3	10h07m	+12.1°
γ Leo	ALGEIBA	2.6	10 18	+20.0°
μ Vel	Mu VELA	2.8	10 45	-49.3°
β UMa	MERAK	2.4	11h00m	+56.5°
α UMa	DUBHE	1.9	11 02	+61.9°
δ Leo	Delta LEO	2.6	11 13	+20.7°
β Leo	DENEBOLA	2.2	11 48	+14.7°
γ UMa	PHECDA	2.5	11 52	+53.9°
γ Crv	GIENA (GEE-nuh)	2.8	12h14m	-17.4°
γ Cru	GACRUX	1.6	12 29	-57.0°
γ Cen	MUHLIFAIN	2.4	12 40	-48.8°
β Cru	MIMOSA	1.5	12 46	-59.5°
ε UMa	ALIOTH	1.7	12 53	+56.1°
ζ UMa	MIZAR	2.4	13h23m	+55.1°
α Vir	SPICA	1.2	13 24	-11.0°
ε Cen	Epsilon, CENTAURUS	2.6	13 38	-53.3°
η UMa	ALKAID	1.9	13 46	+49.5°
η Boo	Eta BOOTES	2.8	13 53	+18.5°
θ Cen	MENKENT	2.3	14h05m	-36.2°
α Boo	ARCTURUS	0.2	14 14	+19.3°
η Cen	Eta CENTAURUS	2.6	14 34	-42.0°
ε Boo	Epsilon BOOTES	2.7	14 44	+27.2°
α Lib	ZUBEN-ELGENUBI	2.8	14 49	-15.9°
β UMi	KOCHAB	2.2	14 51	+74.3°

STAR NAME		MAG.	POSITION	
BAYER	POPULAR		R.A.	DEC.
β Lup	Beta LUPUS	2.8	14h 57	-43.0°
β Lib	ZUBEN-ESCHAMALI	2.7	15h15m	-9.3°
α CrB	ALPHECCA	2.3	15 33	+26.8°
α Ser	UNUK	2.7	15 43	+6.5°
δ Sco	DSCHUBBA (JUBB-buh)	2.5	15 59	-22.5°
β Sco	Beta SCORPIUS	2.6	16h04m	-19.7°
α Sco	ANTARES	1.2	16 28	-26.4°
β Her	Beta HERCULES	2.8	16 29	+21.6°
ζ Oph	Zeta OPHIUCHUS	1.9	16 36	-10.5°
ε Sco	Epsilon SCORPIUS	2.4	16 48	-34.2°
η Oph	SABIK	2.6	17h09m	-15.7°
β Ara	Beta ARA	2.8	17 23	-55.5°
υ Sco	Upsilon SCORPIUS	2.8	17 29	-37.3°
λ Sco	SHAULA	1.7	17 32	-31.1°
α Oph	RASALHAGUE	2.1	17 34	+12.6°
θ Sco	Theta SCORPIUS	2.0	17 35	-43.0°
κ Sco	Kappa SCORPIUS	2.5	17 40	-39.0°
γ Dra	ELTANIN	2.4	17 56	+51.5°
δ Sgr	Delta SAGITTARIUS	2.8	18h19m	-29.9°
ε Sgr	KAUS AUSTRALIS	1.9	18 22	-34.4°
λ Sgr	Lambda SAGITTARIUS	2.8	18 26	-25.4°
α Lyr	VEGA	0.1	18 36	+38.8°
σ Sgr	NUNKI	2.1	18 53	-26.3°
ζ Sgr	Zeta SAGITTARIUS	2.7	19h01m	-29.9°
γ Aql	TARAZED	2.8	19 45	+10.5°
α Aql	ALTAIR	0.9	19 49	+8.8°
γ Cyg	SADR	2.3	20h21m	+40.2°
α Pav	PEACOCK	2.1	20 23	-56.8°
α Cyg	DENEB	1.3	20 40	+45.2°
ε Cyg	Epsilon CYGNUS	2.6	20 45	+33.9°
α Cep	ALDERAMIN	2.6	21h18m	+62.5°
ε Peg	ENIF	2.5	21 43	+9.7°
α Gru	ALNAIR	2.2	22h06m	-47.1°
β Gru	Beta GRUS	2.2	22 41	-47.0°
α PsA	FOMALHAUT	1.3	22 56	-29.8°
β Peg	SCHEAT	2.6	23h02m	+27.9°
α Peg	MARKAB	2.6	23 03	+15.0°







Looking at the MOON

COMPARATIVELY near at 240,000 miles, the moon is a fascinating object showing amazing detail in even the smallest telescope. Technically, the resolution of moon objects is about two times Dawes Limit or R= 9/D. Since linear distances on the moon are approximately 1 mile per second, it is easy to convert angular measure to linear. For example, a 3-in. refractor is rated 9/3 or 3 seconds of arc, which means you can resolve a crater 3 miles in diameter or two similar craters side by side. Much smaller objects in the form of a line can be seen but are not resolved. A typical example is the Straight Wall which is only about 1/8 mile wide and so about 1/8 second in angular width. This is seen "plain as day" but without detail with a 3-in. telescope.

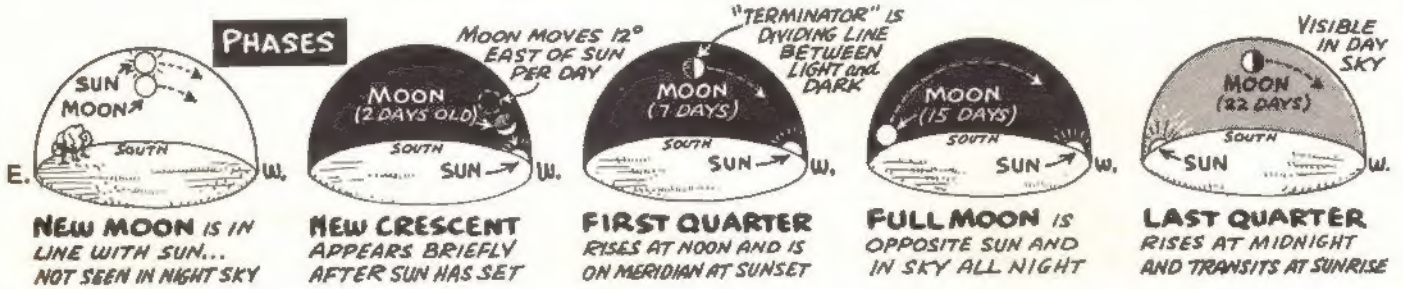
PHASES. One orbit of the moon around the earth is a lunation. It takes 29 days, beginning with the New Moon or no-moon when the moon is in line with the sun and so gets no light on its earth-facing side. But in a day or two the moon moves a little east of the sun, so that a narrow crescent catches the sunlight. The crescent gets fatter every day and in 7-1/2 days the moon is half-illuminated, which phase is called First Quarter because 7-1/2 days is one-fourth of a lunation. After the first quarter, the sunny side continues to get fatter and fatter, finally becoming the fully illuminated Full Moon. After the full moon the lighted area reduces in reverse fashion with the light on the opposite side. Finally only a thin crescent remains and you are back to New Moon again.

LOOKING AT THE MOON. Most moon objects are seen best when on or near the terminator since then the object has a bright side and also a dark shadow. However, the full moon is interesting and shows well the ray system surrounding Tycho, and to a lesser degree, Copernicus and Kepler. Tycho is a beautiful example of a crater, 54 miles in diameter and about 3 miles in depth; Copernicus is about the same diameter but shallower with multiple walls which classify it as a Ringed Plain. The full moon does not obscure crater Aristarchus at the edge of the 2nd Quadrant. This is the brightest spot on the moon. The darkest spot is Grimaldi in the 3rd Quadrant, close to the edge. This is an oval crater with a mean diameter of about 120 miles.

The terminator occurs in all parts of the moon. It sweeps across the moon and back every month, giving you a choice of left or right lighting. From new moon to full, the terminator is the sunrise line; from full to new, it is the sunset line. Either sunrise or sunset light is equally good for most objects, but there are some exceptions, notably the Straight Wall which is a cliff some 800 ft. high sloping toward the east. The wall is seen as a bright line with sunset light, indicating the phase should be about a day past Last Quarter. Lighting from the sunrise side shows no light at all but only a wide, dark shadow.

One of the prettiest scenic areas is the Sinus Iridum or Bay of Rainbows in which Cape Heraclides may be seen (with some imagination) as a beautiful moon maiden when the moon is about 11 days old. Good examples of rills or clefts are Ariadaeus and Hyginus, both slightly below center in the map, both seen best around First Quarter.

DIRECTIONS ON THE MOON. If you look south at the moon, it is natural to label the moon with the same directions of earth, that is North is at the top of the moon and East is on the left. Even when you turn a map upside down, the directions retain their identity. The upside down view is the conventional moon map and it shows the moon as it is seen with an astronomical telescope.



The conventional map is understandable, but it has the oddity of the sun rising in the west and setting in the east. Space engineers have now revised the moon map to standard mapping rules, which puts North at the top and East at the right. The map is shown erect. It is the same old moon, it looks exactly the same, but with the drastic difference the old West side is now called the East side. Specifically, crater Grimaldi is East on old maps (as shown in map above) but West on the new. You can change any old map to new by simply switching the east-west markings at the sides of the map. Some new moon maps skip the confusion by not labeling East or West at all. Then, if you want the old-style map, you mark the Grimaldi side the East side; if you want the space-age orientation you mark the Grimaldi side the West side.

The new directions will cause confusion for many years to come, but eventually it will win out simply because it is the right way to map the moon--the sun rises in the east. Where else?

NAMES on the MOON

ARIADAEUS	are-ee-ADD-ee-us
ARCHIMEDES	are-kuh-ME-deez
ARISTARCHUS	air-is-TAR-kis
ARISTILLUS	air-is-TILL-us
ARISTOTLES	air-is-TOT-il-leez
ARZACHEL	are-zah-CHEL (as in chief)
CLAVIUS	CLAY-vee-us
COPERNICUS	ko-PURR-nick-us
CRISIUM	KREE-see-um
HAEMUS	HEE-mus
HERACLIDES	hair-uh-KLIE-deez
HIPPARCHUS	hip-PAR-kis
PETAVIUS	peh-TAVE-ih-us
PITON	PIE-tun (or PEE-tun)
PLATO	PLAY-toe
PTOLEMY	TOL-uh-me
SINUS IRIDUM	SIGN-us or SEEN-us IRR-ih-dum
THEBIT	THEE-bit
TRIESNECKER	TREEZ-neck-er
TYCHO	TIE-co

CONSTELLATION INDEX

Abbr.	CONSTELLATION	How to Say it	MAP No.
And	ANDROMEDA	an-DROM-eh-duh	2,3
Ant	ANTLIA	ANT-lih-uh	4,5
Aqr	AQUARIUS	ack-KWAIR-ee-us	2
Aql	AQUILA	ACK-will-lah	6
Ara	ARA	A-ruh	6
Ari	ARIES	A-rih-eez	3,2
Aur	AURIGA	or-EYE-gah	3,4
Boo	BOOTES	bow-OH-tees	5
Cae	CAELUM	SEE-lum	3
Cam	CAMELOPARDUS	ka-MEL-oh-pard-us	1
Cnc	CANCER	KAN-surr	4
CVn	CANES VENATICI	KAY-neez Ven-AT-iss-si	5
CMa	CANIS MAJOR	KAY-niss MAY-jer	4,3
CMi	CANIS MINOR	KAY-niss MY-ner	4
Cap	CAPRICORNUS	kap-rih-CORN-nus	2,6
Car	CARINA	ka-RYE-nuh also ka-REEN-uh	4,3
Cas	CASSIOPEIA	kass-ee-oh-PEE-ya	1,2
Cen	CENTAURUS	sen-TAW-russ	5
Cep	CEPHEUS	SEE-fee-us also SEE-fuss	1
Cet	CETUS	SEE-tuss	3,2
Col	COLUMBA	ko-LUM-bah	3,4
Com	COMA BERENICES	KO-mah bear-en-EYE-seez	5
CrA	CORONA AUSTRALIS	kor-OH-nah oss-TRAY-liss	6
CrB	CORONA BOREALIS	kor-OH-nah bo-ree-ALICE (girl's name)	6,5
Crv	CORVUS	CORE-vuss	5
Crt	CRATER	KRAY-turr	5
Cru	CRUX	KRUX	5
Cyg	CYGNUS	SIG-nuss	6,2,1
Del	DELPHINUS	del-FINE-uss	2,6
Dor	DORADO	dough-RAH-dough	3,4
Dra	DRACO	DRAY-ko	1,6
Equ	EQUULEUS	ek-KWOO-lee-us	2
Eri	ERIDANUS	eh-RID-uh-nuss	3
For	FORNAX	for-NAX	3
Gem	GEMINI	GEM-in-eye also GEM-in-knee	4,3
Gru	GRUS	Grr-rus also GROOSE	2
Her	HERCULES	HER-kyou-leez	6
Hor	HOROLOGIUM	hor-oh-LO-ji-um (like horse)	3

Abbr.	CONSTELLATION	How to Say it	MAP No.
Hya	HYDRA	HIGH-druh	5,4
Ind	INDUS	IN-duss	2,6
Lac	LACERTA	la-SIR-tah	2,1
Leo	LEO	LEE-oh	4,5
LMi	LEO MINOR	LEE-oh MY-ner	4,5
Lep	LEPUS	LEE-puss	3,4
Lib	LIBRA	LYE-bra also LEE-bra	5,6
Lup	LUPUS	LEW-puss	5,6
Lyn	LYNX	LINKS	4,1
Lyr	LYRA	LYE-ruh	6
Mic	MICROSCOPIUM	my-kro-SKO-pee-um	2,6
Mon	MONOCEROS	mon-OSS-err-us	4
Nor	NORMA	NOR-mah	6
Oph	OPHIUCHUS	off-ih-YOU-kuss	6
Ori	ORION	oh-RYE-un	3,4
Peg	PEGASUS	PEG-uh-suss	2
Per	PERSEUS	PURR-see-us also PURR-suss	3
Phe	PHOENIX	FEE-nix	2
Pic	PICTOR	PICK-torr	3,4
Psc	PISCES	PIE-sees	2,3
PsA	PISCIS AUSTRINIS	PIE-siss oss-TRY-nus	2
Pup	PUPPIS	PUPP-iss	4
Pyx	PYXIS	PICK-siss	4
Sge	SAGITTA	sah-JIT-tah	6
Sgr	SAGITTARIUS	saj-ih-TAY-rih-us	6
Sco	SCORPIUS	SKOR-pih-uss	6
Scl	SCULPTOR	SKULPT-tor	2
Sct	SCUTUM	SKYOU-tum	6
Ser	SERPENS	SIR-penz	6,5
Sex	SEXTANS	SEX-tanz	4,5
Tau	TAURUS	TAW-russ	3,4
Tel	TELESCOPIUM	tell-ih-SKO-pee-um	6
Tri	TRIANGULUM	try-ANGH-gu-lum	3
UMa	URSA MAJOR	URR-sah MAY-jer	1,5,4
UMi	URSA MINOR	URR-sah MY-ner	1
Vel	VELA	VEE-lah	4,5
Vir	VIRGO	VER-go	5
Vul	VULPECULA	vul-PECK-you-lah	6

To 60° South -- SOUTH POLAR CONSTELLATIONS ARE NOT LISTED

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